THURSDAY, APRIL 8, 1915.

THE COMPLETE WORKS OF TYCHO BRAHE.

Tychonis Brahe Dani Opera Omnia. Edidit I. L. E. Dreyer. Tomus I. Pp. lix + 320. (Copenhagen: Gyldendalske Boghandel Nordisk Forlag, 1913.)

PERHAPS one's first sensation on handling this beautiful volume is one of surprise that three centuries have been allowed to pass after Tycho's death before his writings were given to the world in a collected form; for he took a notable part in building the structure of modern astronomy. He was the first to realise the imperfections of the existing solar and planetary tables, and the fact that their improvement needed prolonged observations with larger and more carefully designed instruments than any that had yet been employed; he fortunately had the skill to design these, and the means to purchase them. Thanks to the bounty of Frederick II., he was enabled to found Uraniborg Observatory, where sun, moon, planets, and stars were observed assiduously for twenty years.

The planetary observations led Kepler to the enunciation of his three laws, those of the moon led Tycho himself to detect the variation and annual equation, also the oscillatory changes of the node and inclination; those of the sun led to the detection of atmospheric refraction, and an approximate measure of its amount. Those of comets showed, by the minuteness of their diurnal parallax, that they were much more remote than the moon, and hence that they were not vapours in our own atmosphere, as many had supposed, but belonged to the planetary sphere. His observations of the fixed stars were far more precise than any previous ones, so that according to Dr. Dreyer the probable error of his standard right ascensions is only 24″; thus we may reasonably conjecture that if Tycho had lived a few years later, and known of the telescopic method, his results might be of utility even in our day.

The present reprint is under the auspices of "Det Danske Spreg og Litteratur Selskab," which has been fortunate in securing the services of Dr. Dreyer as editor. The task is evidently a labour of love with him, as he has made a special study of Tycho's life, having written his biography in 1890; he has written a Latin preface of fifty-nine pages in the present work, giving a biographical outline and a summary of the astronomical achievements; the fuller biography should however, be read by all serious students of his life.

Mr. G. A. Hagemann is generously bearing the cost of the publication of the collected works, which must be considerable, as it is being carried out in a sumptuous manner, with very large, clear type on thick, strong paper, and will run into several volumes.

The heavens themselves signalised in a brilliant manner the advent of Tycho by the outburst of Nova Cassiopeiae in 1572. The memoir, "De Nova Stella," was the first of his published writings, and appropriately begins the collection. "Last year, on the evening of November 11, while contemplating the stars, according to my custom, I observed a new, remarkably bright one nearly overhead. And since from my boyhood all the stars were perfectly familiar to me (such knowledge is not difficult to acquire) it was certain that there had not been even a faint one in that position, much less one of surpassing splendour." Mistrusting his own eyes, he quickly got his neighbours to verify the discovery, which appeared more startling to him than to us, since he knew of no parallel except the star of Hipparchus.

He diligently observed the position of the Nova at various hour-angles, and after some months' observation satisfied himself that it had neither proper motion nor diurnal parallax (on his geocentric hypothesis annual parallax was not to be expected), so he rightly concluded that it belonged to the sphere of the fixed stars; the fact that it scintillated confirmed this view. He estimated its bulk as many hundred times that of the earth, no doubt thinking himself very daring.

His notes on the magnitude and colour are interesting, to compare with those on modern Novæ. In November, 1572, the Nova was much brighter than Venus, so that many people saw it in full daylight; at that time its colour was compared to that of Jupiter. The brightness in December was equal to Jupiter, in February and March to a star of the first magnitude, in May to one of the second. The colour became red like Mars or Aldebaran; later still it became livid like Saturn.

The astrological significance of the Nova is fully discussed; Tycho made some lucky hits; in the next century many people saw in the career of Gustavus Adolphus a striking fulfilment of the horoscope based on the Nova.

The volume before us also contains the horoscopes of the three sons of Frederick II.: Christian, Ulrich, and Hans. Dr. Dreyer notes that astrology cannot be omitted if we desire to enter fully into the thought of that age, and that Tycho could not refuse to draw up these horoscopes when the king, his patron, requested him to do so. Also, belief in planetary influence seems less unreasonable in the case of those who accept

the geocentric hypothesis. Tycho seems to have had some faith in his predictions, but he regarded them rather as warnings of evil tendencies to be resisted, or good ones to be encouraged, than as hard and fast determinations of inevitable destiny. It is rather pathetic to remember that when the eldest prince ascended the throne as Christian IV., he withdrew all Tycho's emoluments, and treated him with such marked coldness that Tycho was glad to leave Denmark altogether, and end his days in exile in Bohemia.

The remaining matter in the volume is an oration on the teaching of mathematics, and a short treatise on practical trigonometry. Tycho had access to seven-figure tables of the natural functions, and made use of the formulæ transforming products of sines and cosines into sums of the same, to save multiplication, logarithms not having been invented.

It is one of the advantages of a verbatim reprint that it satisfies our curiosity on such small matters of procedure, and helps us to realise the everyday life and thought of astronomers of distant ages.

THE RISE AND GROWTH OF BOTANY IN THE UNITED KINGDOM.

A History of Botany in the United Kingdom from the Earliest Times to the End of the Nineteenth Century. By Dr. J. Reynolds Green. Pp. xii+648. (London: J. M. Dent and Sons, Ltd., 1914.) Price 10*s.* 6*d.* net.

MANY British and Irish botanists have been anticipating the appearance of Prof. Reynolds Green's history of the development of their science within the United Kingdom, but its reception cannot but be accompanied with feelings of sincere regret that the author is no longer with us. Indeed, he was seriously ill during much of its preparation, and one should not lose sight of this while perusing its pages. His friend, Prof. Harvey-Gibson, undertook the duty of seeing the work through the press, though, as he states in an appendix to the preface, he has refrained from editing it in any way.

As anyone who is familiar with Green's writings would be led to expect, the book is well arranged, lucid, and clearly written, and it provides an excellent general description of the rise and development of the science of botany amongst us. Opening with a summary of the work of the old writers of herbals, the book goes on to trace the varied phases of the newer advances, the use of botanic gardens, and the recognition and growth of the subject at the universities; it also discusses the more recent ramifications of botany and its points of contact with kindred sciences. A considerable portion of the volume is devoted to an account of the activities of modern and still living botanists. It is full of generous appreciation of the work of his contemporaries, but Green, with characteristic modesty, is almost silent on his own important contributions to vegetable physiology.

We could wish to give a measure of praise to the book more full than mature reflection enables us to do. It is admirable up to a point, and one must remember the disadvantages under which its author laboured, failing health and severe family bereavement, during its production. Without doubt, had Green been spared to see the whole work through its final stages and up to publication, he would have corrected many of the errors one meets with in its pages. It would be ungracious to dwell on these overmuch, but truth to tell the book stands in some need of revision on the score of historical accuracy, and sometimes also in the matter of names of the writers who are quoted. It is, furthermore, not improbable that there may be some difference of opinion as to the correctness of the general perspective, and as to the insight into the relative importance of the work and powers of more recent botanists.

But when this has been said, we may recognise that Green has left us a book of permanent value—a lively impression of the services to science, as well as of the personalities of a number of his contemporaries. The way in which he has treated this part of his subject shows him as a genial friend; perhaps somewhat apt to overvalue those for whom he entertained feelings of personal affection, but to no one is he either mean or unkind.

J. B. F.

OBJECTIVE PSYCHOLOGY—PURE AND APPLIED.

Objektive Psychologie oder Psychoreflexologie; die Lehre von den Assoziationsreflexen. By Prof. W. von Bechterew. Autorisierte Uebersetzung aus dem Russischen. Pp. viii+468. (Leipzig and Berlin: B. G. Teubner, 1913.) Price 16 marks.

Psychology and Industrial Efficiency. By Hugo Münsterberg. Pp. xviii+322. (London: Constable and Co., Ltd., 1913.) Price 6*s.* net.

THESE two books, though widely different in origin and aim, agree in exemplifying a single method of psychological investigation: namely, the method which American writers describe by the ungainly term "behaviourism." It is a psychology in which (to quote Prof. von Bechterew) questions of subjective processes, or processes of consciousness, find no place. The

science defined by this exclusion obviously differs widely from the psychology based upon introspection; it may be regarded as an extension into the human field of the methods developed by Lloyd Morgan in his experiments on the instinctive behaviour of chickens, and by other workers who have followed his highly important lead.

(1) The point of view is explained and defended by von Bechterew in the first fifty pages of his volume. As he conceives it, objective psychology is the science of "psycho-reflexes," that is, of the neural mechanisms the activities of which are either known or supposed to be accompanied by psychoses, whether the subject is conscious of them or not. The remainder of the work is a systematic exposition of the results hitherto obtained by the objective methods, from the analysis of the simpler primary and secondary reflexes to that of the complicated forms of behaviour covered by such terms as will. Many of the researches described have been carried out in von Bechterew's own laboratory in Petrograd; those of other workers are summarised with much ability and with copious references to the original sources. The whole argument is, in fact, developed so clearly and is so elaborately documented that even students who do not accept the author's methodological postulates will find in his book a very valuable collection of material, admirably organised.

(2) Prof. Münsterberg's book is directed less to the student than to the educated layman—particularly to the business man who has heard of the remarkable achievements (and still more remarkable claims) of the pioneers in the "scientific management" of industrial processes and desires to know what a competent psychologist has to say upon the subject.

The author shows by a number of interesting examples, largely from his own laboratory, that the psychologist can help the leader of industry in two specific and important ways. In the first place, by submitting candidates for employment to laboratory tests, he can differentiate with confidence between those whose psychophysical outfit is suitable for the work to be done and those who are unlikely ever to become efficient. Among his illustrations Münsterberg describes, in this connection, the ingenious devices he uses to test the capacity of a man to drive an electric car through busy city streets. In the second place, the psychologist can determine the conditions of rapid and effective training in the performance of skilled acts (*e.g.*, typewriting), and the conditions which will secure the most economical use of the trained worker's skill while minimising the deleterious influences of fatigue and monotony.

In both these departments the "psychology of industry" leads directly to social efficiency in both the narrower and the wider sense; for it tends to the increase both of the productivity and of the happiness of the worker. It is difficult to view with equal approval the investigations into the effects of advertisements and the psychology of the shop-counter, though Prof. Münsterberg's studies of these topics have undoubted interest as explorations of human frailty. T. P. N.

ZOOLOGICAL MONOGRAPHS.

(1) *Reptiles and Batrachians.* By E. G. Boulenger. Pp. xiv + 278. (London: J. M. Dent and Sons, Ltd., n.d.) Price 16*s.* net.

(2) *Some South Indian Insects and Other Animals of Importance, considered especially from an economic point of view.* By T. Bainbridge Fletcher. Pp. xxii + 565. (Madras: Government Press, 1914.) Price 9*s.*

(1) THE prominent features of this convenient volume are the notes on habits, and the illustrations—mostly prints of photographs from life taken by Mr. W. S. Berridge in the Zoological Society's Gardens. Comparative anatomy and the general principles of vertebrate zoology do not come within its scope; but a knowledge of these things being taken for granted, the two classes of reptilia and amphibia are surveyed as detached assemblages. Much after the fashion of the best type of museum catalogue, the distinctive characters of every subordinate group of each class are defined, and the geographical distribution of the minor groups determined; and, much after the fashion of the best type of guide-book, the notable species are succinctly characterised and carefully considered as objects of living interest. A vast amount of well-arranged and easily assimilated information is thus presented to the intelligent reader, not only in respect of structural features, taxonomic relations, life-history, habits, range, and mode of life, but also with regard to popular beliefs and native superstitions, economic bearings, and numerous other matters of interest. Beyond this the author, as one of the curators of the Zoological Society's Gardens, has taken every opportunity of recording interesting facts concerning the behaviour, adaptability, and treatment of reptiles and batrachians in captivity, and of noting their peculiarities, preferences, and other interesting phenomena of their growth and being.

Snakes occupy exactly one-third of the book, and the author has done justice to the subject. With regard to venomous snakes, however, he has scarcely made it clear that in order to inject its venom in lethal amount a snake must not only

strike but must also grip, so as to drive its poison-fangs home and wring out its glands. And with regard to the treatment of snake-bite, he has failed to impress sufficiently upon his readers the important facts (*a*) that the most efficient ligatures and the most powerful local antidotes are perfectly useless if applied after a lethal dose of venom has been absorbed—the available interval, according to the ample and carefully controlled experiments of Captains H. W. Acton and R. Knowles, being from ten to twenty minutes; and (*b*) that after the venom has been absorbed in lethal quantity the *only* hopeful remedy is a suitable anti-venom.

Good and useful as this book is, it is to be regretted that, like so many modern things, it recks so little of the priceless past. Without going back to Herodotus and his entertaining account of the crocodile, the author might have said something about the great pioneers of herpetology.

(2) This is a book that, notwithstanding the limitations of its title, is of much more than local service. Its contents are disposed in three progressive stages, the first dealing with insects generally from a biological viewpoint, the second treating more particularly of insects in their economic range, while the third is at once an exact survey and an illustrated epitome of the specific local forms that affect man and his works for good and ill, but chiefly for ill.

As is natural in a work sponsored by a director of agriculture and a board of revenue, the main end is economic—namely, to place on record what is known about the insect pests of agriculture in southern India, to facilitate their identification, and to explain approved methods of limiting their ravages. Order by order, and family by family, the specific pests are marshalled and individually figured on a lavish scale, referred to their local habitation, characterised in their life-history and economic *rôle*, and relegated to the code of criminal procedure. Beyond this certain forms concerned in the transmission of disease are treated in a practical manner, and many insects of approved utility or potential service to man are individually noticed and portrayed.

The earlier pages that deal with insects as a class in their broad economic incidence are also well done. Among other things they include good chapters on pests as a whole, the general causes that favour their increase, the various means by which they may spread, and the methods adopted for their control. These last, both direct and indirect, are discussed with insight and discrimination, and insecticides of divers kinds, and all the ingenious apparatus of their application, are fully described and criticised; while at the same time the author is careful to emphasise the rational factor underlying all remedial treatment—namely, exact knowledge not only of the life-history of the particular pest, but also of all the local conditions, natural and otherwise, of its particular occurrence. The series of chapters on economic insects brigaded according to *rôle* or circuit—*e.g.* as caterpillar pests, beneficial insects, pests of stores, and so on—are also extremely useful, such collective unities being easy to follow and to tackle.

The preliminary chapters on insect biology, though rather promiscuous and sketchy, are good in intention and are suggestive. In the chapter on "tropisms," however, the author gives his reader no hint that the subject-matter of his definitions and classification lies on the very boundary-line of legitimate inference and beyond the bounds of exact knowledge, and that these "tropisms" are mere imposing words which not only do not explain any process of nature, but are not even generalised expressions of the results of any analysis of natural processes.

The price of the volume, with its fifty beautiful coloured plates and many hundreds of illustrations in the text, is absurdly low, but its weight (5 lb. 6 oz.) is prodigious.

OUR BOOKSHELF.

Memoirs of the Colombo Museum. Series A., No. 1. *Bronzes from Ceylon, Chiefly in the Colombo Museum.* By Dr. A. K. Coomaraswamy. Pp. 31+xxviii plates. (Ceylon: Colombo Museum, 1914.) n.p.

THIS is the first issue of a series of monographs intended to describe the art treasures of the Colombo Museum, among which the bronzes are of special importance. Some of the finest examples have been published in Mr. Vincent Smith's "History of Fine Art in India and Ceylon," but a more complete description of these beautiful objects is welcome. Dr. A. K. Coomaraswamy has contributed a useful introduction. It is not easy to fix the exact date of the bronzes, but they seem to cover the period beween the ninth and fourteenth centuries, A.D. They fall into two groups: Buddhist and Saiva Hindu. The discovery in Ceylon of many images of Bodhasattvas and female Mahāyāna deities is important because it proves that the latter cult existed in the island, and that it is now more than ever inaccurate to speak of Northern and Southern Buddhism as if these geographical terms connoted a distinction between the Hīnayāna and Mahāyāna schools. In this connection the images of Brahmanical deities absorbed into Buddhism are of special value.

The Saiva Hindu bronzes, like those from Polonnāruva, differ widely from the Buddhist

group: they may have been cast in Ceylon, but as a group they are allied to the school of South India. Their existence may represent a Tamil occupation of the island, but it is possible that both Buddhist and Hindu cults may have been contemporaneous. Siva here is found performing his orgiastic dance, and he is accompanied by his Sakti, or female energy, the Mother of the Universe, source of power and fertility. Finally come the local deities, like Pattini, patron of chastity and guardian of disease, who was a deified woman executed on a false charge of stealing the anklet of the Queen of Madura. The bronzes thus represent a complex of cults: Buddhism, Brahmanical Hinduism, and the worship of local deities, all combined by the eclectic tendencies of modern Hinduism. Those who are interested in Ceylon will welcome the promised publication in this series of monographs on the local archæology, ethnology, and botany.

A Text-book of Practical Assaying, for the use of Mining Schools, Miners, and Metallurgists. By Prof. J. Park. Pp. xii+342. (London: C. Griffin and Co., Ltd., 1914.) Price 7*s.* 6*d.* net.

THIS capital little book is a welcome addition to the lengthening list of treatises on assaying which are available in this country. It has already appeared in New Zealand, where it has been used for the last ten years as a text-book in many class-rooms. It is arranged as a course of instruction for students, intended to be spread over two years, beginning with the easier operations and gradually leading up to more difficult ones.

The book contains a comprehensive course, and in his zeal for completeness the author towards the end so far diverges from his own definition of assaying as to include the analysis of soils, manures, sugar, and milk. Nevertheless, it must not be assumed that everything is fair game which comes into the net of this well-known professor of mining. There is little which could be omitted with advantage. It will readily be believed, however, that one of the merits of the book is conciseness, and in some sections strength would be gained by expansion and the addition of a few more details, as, for example, in the assay of copper by electrolysis.

The book is also commendable in its accuracy, and it will be prized by students who are familiar with it after they have passed out into the works laboratory.

The directions for arithmetical computation of results are perhaps unnecessarily full and explicit for university students, and such a remark as the following might be omitted:—"Suppose one gramme of copper ore yielded 0·46 gramme of copper, then the percentage is equal to 46." Some other directions in the book are similarly elementary, but teachers of classes in secondary and technical schools will not object to it on that account. For these classes it is an eminently suitable book. A few more illustrations of apparatus would not be amiss. T. K. R.

New "Acribo" Sectional Pads. Fifty sheets in a pad with cover. (London: W. H. Harling.) Price of each pad, 2*s.* 6*d.*

MR. HARLING'S new pads of squared paper are printed in grey with a view to obviate eye strain and to ensure prominence for the curves plotted. Three rulings are available: inches and eighths, inches and tenths, and centimetres and millimetres. The size of the ruled portion of each pad is 10 in. by 8 in. or 26 cm. by 20 cm. The paper is excellent, the ruling is accurate, the pad is convenient, and the production is British throughout.

The Counties of Clackmannan and Kinross. By J. P. Day. Pp. viii+145. (Cambridge: At the University Press, 1915.) Price 1*s.* 6*d.* net.

The Counties of Moray and Nairn. By Charles Matheson. Pp. x+139. (Cambridge: At the University Press, 1915.) Price 1*s.* 6*d.* net.

THESE recent additions to the series of Cambridge County Geographies maintain the high standard of attractiveness and utility to which attention has been directed in the case of many previous volumes. The books should become popular guides for tourists, who will appreciate the interesting style in which they are written.

MODERN SUBSTITUTES FOR BUTTER.

UNTIL the last few years the word margarine was usually associated, in the mind of the British public, with poverty; but now, under the new name of "Nuts and milk," with which advertising enterprise has made us familiar, it is becoming freely used in the kitchen, and is even found on the breakfast table in many households. On the continent, where the general standard of luxury is not so high as here, butter substitutes are used far more generally; and the demand for the raw materials from which they are made has increased to such an extent as to cause a noteworthy increase in their cost. In most cases the legislation affecting butter substitutes has been influenced by vested interests, so that, whilst only partially effective in preventing fraud, it has checked the development of the industry. Taking into account also the universal prejudice against margarine which prevailed formerly, it is very remarkable that the industry should have made such advances. It is of interest, therefore, to examine its development in some detail, more particularly from the scientific point of view; for it is desirable at the outset to emphasise that the margarine industry is essentially scientific in character, and that considerable technical skill is demanded in its manufacture.

The finished margarine must be satisfactory in taste, odour, and texture; this necessitates that the fats composing it shall be entirely free from fatty acids, and show no tendency to become rancid. Much depends on the texture of the fat, which the user expects to be the same as that of butter. The margarine maker so blends his raw materials that the mixture has the same melting

point as butter, and he is able, further, to vary the melting point to suit the climate, an advantage which will be more fully appreciated in the future when margarine has found its way to tropical countries.

The present success of the margarine manufacturer is to a large extent due to the great variety of raw materials which are now available. In the early days of the industry soft beef fat was the sole basis obtainable; this was known as oleo oil or oleomargarine, and the conditions of its manufacture were not always above suspicion. This has now been entirely changed; the factories are models of cleanliness; they are officially inspected, and above all, animal fats have become of secondary importance to vegetable oils.

The process of manufacture is briefly as follows:—The carefully purified oils are blended at a suitable temperature, churned and pulverised with new or separated milk in suitable machines, cooled, washed, salted if required, and worked in exactly the same way as butter. The product is a butter substitute, and has the same composition, viz., about 84 per cent. of fat. Therefore on the accepted standards it has the same nutritive value.

A certain amount of butter fat is usually contained in the mixture, but by law this is not allowed to exceed 10 per cent. In Germany, Austria, and Denmark the presence of 10 per cent. of Sesame oil is obligatory for the purpose of earmarking the substitute. Sesame oil gives a colour reaction with certain reagents, which enables its presence to be very readily detected; for the British palate this addition of Sesame oil is unwelcome. In Belgium the addition of 0·2 per cent. of potato starch, as well as of 5 per cent. of Sesame oil to margarine is obligatory. It may be remarked that the analytical discrimination between butter and margarine is a lengthy process, and that the detection of 10 or 15 per cent. of added fat to butter is a matter of considerable difficulty. All fats are very much of the same composition, and with one or two exceptions they lack individual characteristics. The analyst depends, therefore, on small differences in physical characteristics, or on the proportion of fatty acids of low molecular weight, for their identification when in admixture.

It is an increasing practice in factories and for culinary operations in restaurants or in the kitchen to use the pure or blended fats themselves without churning them with milk. The advantages of this procedure are obvious, and it will be followed more generally by the housewife in the future. Thus in the United States, and in the poorer districts of our large towns, enormous quantities of refined cotton seed oil are sold for frying purposes, and the use of nut and blended butters containing 100 per cent. of fat for the same purpose is largely on the increase amongst the upper classes.

With the exception of olive oil the edible vegetable oils require very special refining before their characteristic flavours or impurities can be removed; in consequence it is only since these difficulties have been overcome in practice that they have been so largely used for margarine. It is certain that as the knowledge of refining processes increases, the development of the industry will be still greater. The methods of refining vary according to the oil; they are mostly jealously guarded as valuable secrets.

In Britain, and particularly in the United States, very large quantities of cotton seed oil are used either in margarine or for culinary purposes, both as a substitute for olive oil and as a cooking fat. About three-fourths of the world's production comes from the United States, about half of this oil being refined for edible purposes. The crude oil obtained by pressing the seed is first treated with caustic soda, then with fuller's earth, and finally made as nearly as possible free from taste and odour. From the point of view of the margarine maker, cotton seed oil is too liquid to be used in any large proportion, though its relatively low cost makes it a very desirable ingredient.

Far more important as butter substitutes are the nut oils—coco-nut, and palm kernel. The former is obtained by pressing copra—the flesh of the coco-nut, which is exported in a dried condition from its place of origin. In the past the copra-pressing industry has been localised at Marseilles, though in later years an almost equal quantity of material has been dealt with at Hamburg.

Palm kernels are the seeds of the palm fruit, of which the fleshy part is utilised for the manufacture of palm oil. The natives on the West Coast of Africa collect the kernels, crack and remove the shell before the nuts are exported to Europe. It is stated that kernels were first brought to Marseilles as ships' ballast and thrown into the sea on arrival until their value was recognised. Originally the chief receiving port was Marseilles, but latterly the industry has been almost entirely carried on at Hamburg, where in 1911 93 per cent. of the total quantity was dealt with, the remainder going to Liverpool.

The palm kernel oil made in North Europe last year is estimated at 125,000 tons, of which about 40,000 was refined for edible purposes. The kernels contain about 50 per cent. of oil, which is extracted by pressing in hydraulic presses similar to those used for copra. The residue, palm kernel cake or meal, has found a very wide use in Germany as an ingredient of compound cake for cattle feeding, and in this form has been largely exported to England. The commercial success of the pressing industry largely depends on the price obtained for this meal, and no pains have been spared on the Continent to demonstrate its value to the farmers by means of scientifically conducted feeding trials. There is at present much talk of developing the industry in Britain, in which case the disposal of the cake here will be an important consideration. It is of interest that the decline of the industry in Marseilles is largely due to the cake failing to find a ready sale

as cattle food in the South of France. If the new industry is to succeed here it will have to be supported by the agricultural interests.

Some idea of the magnitude of the nut-oil industry is gained from the following figures:—The world's production of coco-nut and copra oil 1913-1914 is estimated at 377,000 tons, of which 300,000 tons were used in Europe. The total supply of hard vegetable fats (coco-nut and palm kernel oil) available for margarine is said to have been 240,000 tons in 1913, and perhaps 300,000 tons in 1914. Out of 347,000 tons of hard fat stated to be used for margarine in 1913, 204,000 tons were vegetable, and the quantity of vegetable fat used in 1914 may have amounted to 300,000 tons, *i.e.*, the total visible supply. There is little wonder that there has been a great increase in the price of these oils, and that the tropical sources of palm tree oils are being widely exploited. Nearly all tropical countries report an increase in the area under coco-nuts, or an improvement in the methods of dealing with the existing trees, and in the machinery for making copra or extracting the oil, which is still very primitive and inadequate.

The nut oils resemble butter and differ from all other fats in containing a large proportion of fatty acids of low molecular weight. Butter contains acids from butyric acid upwards in the homologous acetic acid series; the chief constituent of nut oils is lauric acid. Few of the remaining oils of commerce contain acids lower in the series than palmitic acid.

In preparing vegetable fats for the market the all-important consideration is the careful selection of the raw materials. The oil is worked as fresh as possible, so that the best results are obtained when the seed is pressed in this country. It should be understood that the refining process involves no treatment with chemicals except the agitation with weak alkali to remove the fatty acids present.

The importance of fats in the dietary requires no emphasis; on the other hand, it is questionable whether all fats have the same value as food materials. Fats, being glycerides, are decomposed in their passage through the alimentary system into glycerol and fatty acids. The decomposition is effected through the agency of an enzyme, lipase, so that the digestibility of the fat depends on the rate at which it is attacked by the enzyme. The fat has to be brought into a suitable state of emulsification before the enzyme can act on it; and though the factors controlling this state are still somewhat obscure, it is above all important that the fat should melt readily at the temperature of the body. Hence the comparative digestibility of a fat is in the first place based on its melting-point. Stearine is badly digested, liquid oleine is readily digested. The addition of sufficient oleine to stearine so as to reduce the melting-point of the mixture renders the stearine also digestible. Consequently the all-important point which margarine makers keep in view is the melting-point of their product in relation to the body temperature; if this is correct the material may contain some ingredients of a considerably higher melting-point.

It is of interest to note in this connection that vegetable fats are composed to a great extent of mixed tri-glycerides—that is, the glyceride contains more than one fatty acid in its molecule, whereas normally one molecule of glycerol is coupled with three molecules of the same fatty acid. Experience teaches that the melting-point of the fat will be greatest when these are all the same. The melting-point of the fat is further influenced by the fact that it consists of a number of different glycerides, both simple and mixed. Since mixing of fats has the result of altering the relative proportions of these it is evident that the final melting-point of a mixture cannot be predicted on theoretical grounds, and it is agreed that butter substitutes of suitable melting-point are as digestible as butter.

It is customary to measure approximately the nutritive function of a food by its energy value in calories per pound, but modern research has shown this method to be inaccurate in two respects. In the first place it ignores the quality of the food; secondly, it neglects the presence in traces of the vitamines.

It has been found by experimenting with isolated food substances that diets otherwise sufficient in energy value fail to maintain growth and health unless they contain certain substances hitherto unrecognised, but which have been named vitamines. The work in this field is of recent date, and is vitiated by the usual errors accompanying premature publication—indeed, much of it has been recalled already, but it would appear that the vitamines are of lipoid nature. They are present in butter, but not in the refined fats which are used for butter substitutes. How far this difference is of importance it is difficult to say; probably sufficient vitamines are present in the rest of the dietary to enable them to be dispensed with in the fat.

The question of quality is of more importance, though it has hitherto largely escaped attention. The individual fatty acids probably differ in their value in somewhat the same way as the different amino-acid constituents of the proteins have been shown to do, though to a less extent. The lower fatty acids in butter are perhaps specially important in making it of more value than olive oil, which is composed mainly of oleic acid, or than fats composed entirely of palmitic and stearic acids. Nut oils, however, resemble butter in containing a proportion of the lower acids, and hence their use in butter substitutes is entirely rational from the point of view of nutritive value.

In the foregoing the nature and preparation of materials available for use as butter substitutes have been indicated and their food value discussed. When it is remembered that the new industry is under rigid scientific control and conducted with a cleanliness mostly unknown in the butter industry, and, moreover, that it has made edible fats available for the masses at half the price of butter, it must be proclaimed as yet another of the achievements of science in the service of man.

THROUGH THE INTERIOR OF BRAZIL.[1]

IT is an instance of rare good fortune for a man who delights in the life of a field-naturalist to be offered the honorary leadership of a scientific expedition, by a Government not his own, through a large stretch of unexplored tropical country, to embark upon an unknown river, piecing it together with others but hazily known, and to have the now complete large river called after himself. However unique such a stroke of luck, the necessary premises are equally rare in their combination of an ardent naturalist, keen sportsman, vigorous experienced traveller, leader of men as a former president of the great American Republic, and attractive, versatile writer!

The idea of a journey through the interior of Brazil had been suggested to Colonel Roosevelt by Father Zahm, a missionary. It took shape when he was invited, through the Governments of Argentina and Brazil, to deliver addresses to their various learned societies, and he decided to combine this visit with a collecting tour for the American Museum of Natural History. When at Rio, the Government offered him the conjoint leadership of a scientific expedition which the Telegraph Commission was going to make through the very heart of the continent, down the now famous Rio Duvida. The geographical problem may be illustrated as follows. Let my right arm represent the lower Amazon river, the thumb the Tapajoz, the middle finger the Madeira, the index its most eastern and last tributary. The first joint of the index finger was known as the lower Aripuanan, composed of the upper Aripuanan and the Castanho river; this, the second joint, was known to rubber men only. The third joint represents the Duvida. A few miles of this river had been discovered by the Telegraph Commission in 1909, and there was a long gap between it and the Castanho of unknown extent. Moreover, it was not unlikely that the Duvida was, after all, but a tributary of the Gyparana, an affluent of the Madeira, already well known; and it was just possible that the river of Doubt turned sharp to the east and fell into the Tapajoz. However, the authorities ordered a party to ascend the Aripuanan up to the mouth of the Castanho and there to wait for the explorers.

The American party consisted of the Colonel and his son, Messrs. Miller and Cherrie as experienced zoological collectors, Fiala, of Arctic experience, as the handy man, and Father Zahm. Well found and equipped they left Asuncion on December 9, 1913, and ascended the Paraguay up to the headquarters of the Telegraph Commission, about 15° S. There is, extending towards northwest, the Serra Geral, the divide between the La Plata basin and that of the Amazon, but recently explored, with its numerous streams, by the Commission. Here the collections hitherto made were sent back, with Father Zahm. Fiala, with a few companions, was sent down a tributary of the Tapajoz. They got through, down this river, having lost everything but their lives. On February 3, 1914, the main party continued the journey with mule packs and ox carts, still following the telegraph and crossing many streams. Miller, with a small party, went on, to descend the Gyparana, etc., for Manaos, which turned out a most successful collecting trip. The main party combined with the Brazilian members: Colonel Rondon, chief of the Commission, Lieut. Lyra, and Dr. Oliveira.

FIG. 1.—One of the canoes. From "Through the Brazilian Wilderness."

They embarked upon the Duvida on February 27 in seven dug-outs, with sixteen paddlers, twenty-two men all told, with provisions for fifty days, hoping to reach the Madeira within six weeks. The starting point was at 12° 1′ S.; 60° 15′ W. All went well until March 3, when at 11° 44′ S. the first rapids were encountered. Then began the misery of portaging, carrying the loads and dragging the clumsy dug-outs through or past rapid after rapid, amidst dense forest, in the rainy season, with a plague of biting ants, flies, and termites which devoured their outfit. Nevertheless, the Colonel was "reading poetry in head-net and gauntlets." On one occasion it took them three full days to negotiate one mile of rapids. By March 25 they had descended only 160 kilometres of the winding river, had lost four canoes,

[1] "Through the Brazilian Wilderness." By Theodore Roosevelt. Pp. xiv+374. (London: John Murray, 1914.) Price 18s. net.

including a new one made on the way, with provisions, ropes and pulleys, and one of the crew. A dog was killed by unseen Indians, the outfit had to be cut down to the utmost, and the sadly shrunk provisions had to be supplemented by palm-tops, fish, nuts, and an occasional monkey or wood-fowl. Illness, and a case of murder amongst the crew added to the depression.

Things were at their worst, when the river became more manageable, and when, on April 15, they came to the first house of rubber men, who informed them that they were on the Castanho river, about fifteen days from its confluence with the Aripuanan. This happened at 10° 24′. Henceforth, they enjoyed every help, and on April 26 they made the mouth of the Castanho, at 7° 34′, where Lieut. Lyra was encamped, waiting for the explorers. On the last of the month all the parties met at Manaos. By discovery and piecing together they had put on the map a new river;

FIG. 2.—Rapids of the Duvida. From "Through the Brazilian Wilderness."

allowing for unknown headwaters and the windings of its whole, rather straight course, amounting to a total length of 1000 kilometres, not miles. This river enjoys now an abundance of names. Duvida + Castanho + Lower Aripuanan = Rio Roosevelt, as proclaimed officially by Colonel Rondon, but in one of the two maps of the book it is called Rio Teodoro. It was a very successful expedition, its object having been obtained in the way it had been planned.

The various collections amounted to the great number of 3000 birds and mammals. Concerning the description of the country, its people, fauna, and flora, the narrative divides itself naturally into two parts. Soon after reaching the Duvida the pleasant occupation of collecting and observing had to give way to dangerous toil, the ways and means of getting through at all. Up to the divide Colonel Roosevelt had a glorious opportunity of indulging in the study of nature in her most varied aspects. He kept his eyes open, and, with a pleasant style, shows his delight whenever he comes across some creature he had not seen before. At the outset, at a visit to the serum-therapeutic institute at São Paulo, we get a lecture on snakes and their poison, and he assisted in experimenting with the mussurana, a snake-eating, harmless, immune snake. But we are not told its scientific name (*Rhachidelus brazili*, Blgr.) one of many similar regrettable instances in his book. The technical names are, of course, the bane of the vast majority of readers. Vernacular names are preferable, but there is a limit, and two words in brackets would satisfy everybody.

He speculates whether the white-tailed deer is an immigrant from the Northern Continent, arguing from the season of the shedding of its antlers. The marsh-deer, with its advertising red coloration, is just as successful as the black- and the white-tailed deer, which are found in the same neighbourhood. "Evidently it is of no survival consequence whether the running deer displays a white or a black flag." Pumas, ocelots, jaguars, spotted or quite black, were killed in the same locality. "In many cases coloration is of no consequence whatever; instead of being a survival factor, it becomes negligible through the other factors of overwhelming importance, as habits, cleverness, etc." Thus speaks the experienced sportsman on one of his favourite subjects. On another occasion he is puzzled why the jaguar should climb trees to escape dogs, "for ages have passed since there were in its habitat any natural foes from which it needed to seek safety in trees." Such and similar arguments usually do not come to much, but they are samples of scores that he did not go out merely to bag his jaguar. Birds, beasts, coral snakes, and piranha fishes, toads and ants, and primitive natives, he has something to say about, not always new, but to the point.

Every naturalist will agree with him that the mere collecting for museums is all very well, to a certain extent, a necessary evil, but what is now wanted are observations of the economy of the creatures, as parts of their environment. To secure such information, send out educated men who can give a readable account of their experiences. With exception of the two very sketchy maps most of the fifty illustrations are beautiful and characteristic.

H. G.

THE "ORIGINAL" SPECIFIC GRAVITY OF BEER.

THE December (1914) issue of the Journal of the Institute of Brewing is an important number of this publication, and of more than merely technical interest. It contains a series of reports and memoranda upon the subject of the determination of the "original" specific gravity of beer, and the results of the work described have now, by the Finance Act of 1914, been legalised as the basis for checking or determining the charge of duty upon this beverage. The main reports are contributed jointly by Sir Edward Thorpe and Dr. H. T. Brown, and the latter author supplements them by interesting studies of both the historical and the scientific aspect of the question.

Beer is taxed as being an alcoholic beverage, and it is popularly supposed to pay duty according to the amount of alcohol it contains. This, however, is not strictly the case. The basis of taxation is not the actual quantity of alcohol in the beer, but the specific gravity of the unfermented wort, which may be regarded as a measure of the quantity of alcohol potentially producible. Essentially, the wort of beer is a solution of various sugars—maltose, dextrose, cane sugar, and invert sugar—either arising from the malt and grain used, or directly added as such. The proportion of sugars varies considerably, according to the kind of product desired. In wort for producing strong ale, for instance, there may be twice as much sugar as in that destined for ordinary table beer. But, in the main, the proportion of sugar determines the specific gravity of the unfermented wort, and the specific gravity is therefore made the basis of the charge of duty levied on the beer. A brewer is thus left at liberty to ferment his wort as much or as little as he likes, and to produce a stronger or a weaker, a heavier or a lighter beverage, as his fancy dictates or his customers prefer.

As soon as fermentation commences, the specific gravity of the wort begins to alter, and in general to decrease. This is so for two reasons. First, the destruction of sugar by fermentation removes solid matter from solution; and secondly, the alcohol produced is specifically lighter than the wort. Hence, unless the specific gravity is determined before fermentation has commenced it is useless as the basis for the correct assessment of duty. It is impracticable, however, to have a revenue officer in attendance in all cases to take the specific gravity of the wort before fermentation begins; moreover, it often happens that the "collection" of the wort extends over several hours, during which time the first portions may have been in contact with yeast, and fermented to an appreciable degree, before the last portions have been added. Even were this not so, other difficulties arise. A large quantity of beer is exported, and the exporter is entitled to a "drawback" or rebate equivalent to the duty originally charged upon the unfermented wort from which the beer was made. Hence it is necessary to devise a method whereby the original specific gravity of the unfermented wort can be ascertained by the analysis either of the partly-fermented wort or of the finished beer, as the case may be.

As a first approximation, such a method may be based upon the well-known equations of Gay-Lussac denoting the conversion of sugar into alcohol. With maltose, for example, it is readily calculable from the equation:—

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + H_2O = 4\underset{\text{Alcohol}}{C_2H_6O} + 4CO_2,$$

that 100 parts of this sugar yield theoretically 53·8 parts of alcohol. Hence by determining the quantity of alcohol in a given specimen of wort or beer, we find the equivalent amount of sugar destroyed; and from the known density of solutions of maltose we can thus deduce the corresponding loss of specific gravity. Adding the number denoting this loss to the specific gravity of the residual wort or beer freed from alcohol, we can, theoretically, obtain the "original" specific gravity of the wort, *i.e.*, the gravity before fermentation had commenced.

In practice, however, this calculation is not sufficiently accurate. As Pasteur long ago showed in his studies of fermentation, a part of the sugar destroyed is not converted into alcohol. Moreover, different classes of sugars yield different percentages of alcohol. Again, the introduction of yeast complicates the matter, since part of the solid matter of the wort is used up in sustaining the growth of the yeast, and a sensible quantity of alcohol may be added as such with the yeast itself. These and other disturbing factors, small individually, together affect the result sufficiently to render the figures given by the simple theoretical method, as outlined above, only an approximation to what obtains in actual brewery operations.

We have, in fact, to fall back upon an empirical basis for the calculation of results sufficiently accurate to be used in practice. Starting with worts of known specific gravity, fermentations may be carried out, and from the examination of samples drawn as the process continues, it can be ascertained experimentally what is the actual loss of specific gravity consequent upon the production of known quantities of alcohol. Such experiments, in fact, have been made, and the results have been embodied in statutory tables for use in assessing the duty on beer.

Manifestly it is of much importance that these tables should be true and just. If inaccurate in one direction they are unfair to the public by reason of the loss of revenue entailed; if erroneous in the opposite sense they are unfair to the brewer.

The first original gravity tables were constructed in the year 1847 by Messrs. Dobson and Phillips, of the Inland Revenue Department. They were drawn up with considerable care; but some discussion having arisen, the whole matter was referred a few years later to Profs. Graham, Hofmann, and Redwood, whose report was pre-

sented to the authorities in 1852, and published the same year in the Journal of the Chemical Society. For some time past it has been known that the table supplied with this report is less accurate than is desirable—not, it appears, from any inherent errors, but from having been based upon fermentations which differed in some respects from those obtaining in ordinary brewery practice. About six years ago, therefore, the Commissioners of Customs and Excise gave instructions for a revision of the table to be made. This was undertaken by Sir Edward Thorpe, who was at that time principal chemist of the Government Laboratory, conjointly with Dr. H. T. Brown, nominated on behalf of the brewing trade by the Council of the Institute of Brewing. The necessary experiments, which altogether extended over a period of about two years, comprised not only brewings made under laboratory conditions, but an extensive series of observations at representative breweries, in order to obtain data which should correspond fairly with the actual working conditions met with in modern brewing practice. In the result a table has been constructed which there is every reason to believe is trustworthy, and which has now been legally established for use in place of the former statutory table of Profs. Graham, Hofmann, and Redwood. As compared with the older table, its general effect is somewhat to increase the amount of duty chargeable.

Dr. Brown's special contribution is a valuable study of the scientific principles underlying the empirical method of determining original specific gravity. He shows that a reasoned or "theoretical" process is quite possible—though not necessarily preferable—if the data have been properly established. C. SIMMONDS.

ROLL-CALL OF BRITISH BIRDS.[1]

WE have received from the British Ornithologists' Union the second and revised edition of its "List of British Birds." It is an authoritative compilation which does credit to the zeal and carefulness of the editorial committee. While the task was only accomplished by division of labour, the whole has been revised by the entire committee, who consider themselves jointly responsible, although many disputed points have been decided by the votes of the majority. The first edition, published in 1883, included 376 birds; the present edition has 475, quite apart from a long list of species the presence of which has been recorded, but not satisfactorily proved.

It is interesting to look into the composition of the list of 475 birds. In the first place, 188 are regular breeding birds, and 286 are non-breeding, and one (the great auk) is extinct. The list may be further sub-divided. Thus, there are 141 residents, including, of course, many that are partially migratory. In this category are included three introduced birds—the little owl, the pheasant, and the red-legged partridge, besides the capercaillie, which was indigenous, but became extinct about 1760–70, and was re-introduced from Sweden in 1837–8. A second set is made up of 47 summer visitors, including a few which occasionally leave representatives with us in winter. The third set consists of 46 winter visitors; the fourth of 30 birds of passage; the fifth of 61 occasional visitors which have occurred on more than twenty occasions.

The largest category in the classification is that of rare visitors, which have been recorded on fewer than twenty occasions. This group numbers 149, which shows how diligent the search for the occurrence of rare birds has been in the British Islands. Under each bird we find a few references, the etymology of the name, the distribution in the British Islands, and the general distribution. A long appendix is devoted to the birds which have been excluded because the evidence of their occurrence is not regarded by the committee as entirely satisfactory. Two others deal with questions of nomenclature. The members of the committee deserve the thanks of all ornithologists for the effectiveness with which they have done their work, which must have made heavy demands on their time and afforded abundant exercise for their judgment.

[1] "A List of British Birds." Compiled by a Committee of the British Ornithologists' Union. Second and Revised Edition. Pp. xxii+430. (London: W. Wesley and Son, 1915.) Price 7s. 6d.

NOTES.

WE learn with much regret of the sudden death on March 23, through heart-failure, of Prof. Otto N. Witt, professor of chemical technology in the Technical High School at Charlottenburg.

DR. F. TAYLOR, consulting physician to Guy's Hospital, has been elected president of the Royal College of Physicians in succession to Sir Thomas Barlow.

THE fifth annual award of the Willard Gibbs Medal, founded by Mr. W. A. Converse, of Chicago, has been made, says *Science*, to Prof. A. A. Noyes, director of the research laboratory of physical chemistry, Massachusetts Institute of Technology.

A STRONG after-shock of the Avezzano earthquake of January 13 was felt in Rome on April 5, at 7.20 a.m. (6.20 G.M.T.). According to a report issued by the geodynamic observatory at Rome, the epicentre of the after-shock appears to have been close to Avezzano.

THE American Philosophical Society will meet at Philadelphia on April 22–24 for the reading and discussion of papers. The programme includes papers on many subjects of recent research in physical and natural science, and also a symposium on the earth: its figure, dimensions, and the constitution of its interior.

DR. J. SCOTT KELTIE, who has been secretary of the Royal Geographical Society since 1892, vacated that office at the end of last month, and has been succeeded by Mr. A. R. Hinks, who has been assistant secretary of the society since 1913. Dr. Keltie will not, however, entirely sever his official connection with the society, for he has undertaken to act with Mr. Hinks as joint-editor of the *Geographical Journal* for the next two years.

IT is announced in the issue of *Science* for March 12 that Col. George W. Goethals has been promoted to be a major-general of the line in recognition of his services in the construction of the Panama Canal. Brig.-Gen. William C. Gorgas, surgeon-general, has been promoted to be major-general in the medical department. Col. H. F. Hodges and Lieut.-Col. W. L. Sibert, U.S. Corps of Engineers, have been promoted to be brigadier-generals. The Bill authorising these promotions extends the thanks of Congress to the officers mentioned.

WE regret to see the announcement of the death on Sunday, April 4, at fifty-eight years of age, of Dr. H. Lewis Jones, medical officer in charge of the electrical department at St. Bartholomew's Hospital, and a leading authority upon electro-therapeutics. Dr. Jones was president in 1903–4 of the British Electro-Therapeutic Society, and acted as official delegate for the British Government to the International Congress of Physiotherapy at Liège in 1905, and also at Paris in 1910. He was the author of "Medical Electricity," and of numerous papers on the principles of ionic medication and related subjects.

THE desirability of excluding cotton from Germany and Austria has been urged upon the Government by a number of men of science. At a conference on March 10 a letter was drawn up and sent to Lord Moulton at the High Explosives Department of the War Office, pointing out that Germany is entirely dependent on her imports of unspun cotton for the manufacture of propulsive explosives, and asking whether a complete embargo on cotton destined to Germany and Austria by any channel had been declared and would be exercised. Among the signatories to the letter were Sir William Ramsay, Prof. Clowes, Sir Alex. R. Binnie, Prof. H. Jackson, Mr. B. Blount, Prof. Meldola, and Prof. W. J. Pope. Lord Moulton replied on March 19 to the effect that the Order in Council of March 11 would, he thought, satisfy the signatories, who, however, on March 22 pointed out that the Order in Council would become effective only if cotton were made contraband of war. Further correspondence has taken place, and the signatories have had an interview with the Board of Trade, but they appear to have been unable to obtain the assurance they desire for the prevention of the importation of cotton by Germany.

THE present shortage in this country of synthetic yellow dyes has put difficulties in the way of manufacturers of khaki cloth. A temporary way out of the difficulty was found, however, by the increased use of fustic, a natural yellow dye-stuff, consisting of the wood of a tree (*Chlorophora tinctoria*) which grows freely in Jamaica and also in British Honduras. When the shortage of yellow dye-stuffs first became apparent the Imperial Institute took steps to place British dye firms in touch with exporters of fustic in Jamaica. Only a moderate amount of cut fustic wood was, as it happened, then available in the island, but, as a result of the institute's action the Government of Jamaica has offered to purchase from the growers further supplies, and carry these at Government cost to Kingston, the port of shipment. Negotiations are accordingly now pending for the purchase and shipment of considerable quantities of Jamaica fustic by dyers in this country. The Government of British Honduras is also taking action in this matter, and a further supply of the wood may possibly be forthcoming from that Colony. Further information may be obtained on application to the Imperial Institute, South Kensington, London, S.W.

BY the death of Mr. J. J. Beringer on March 28, Cornwall has lost an indefatigable worker whose investigations in the science of mining and metallurgy made him one of her most prominent and interesting personalities. A personal friend, W. H. T.-J., sends us the following particulars of his career and work. Born at Penzance, Cornwall, in 1857, Mr. Beringer was educated at Redruth. In 1877 he won a Royal Exhibition, and took the course of the Royal School of Mines in London. In 1880 he passed his examinations with distinction, and secured his diploma A.R.S.M. In 1881 he became assistant in the chemistry and assaying department to Prof. Huntingdon at King's College, where his work was very highly appreciated. From 1882 to 1891 he was lecturer to the Miners' Association, also public analyst for the county of Cornwall. From 1882 down to the date of his death, he was principal of the County School of Metalliferous Mining, Camborne, of which he also was made a governor, and it is mainly in that position that he distinguished himself as a lecturer of remarkable ability on mining and metallurgical subjects, not only by his erudition, but also by his sympathetic hold on his students. He was the author of a text-book on assaying, which has gone through some ten or more editions, and remains to-day the standard text-book in Great Britain, and may be said to be used in nearly all schools of mines throughout the world. The Institution of Mining and Metallurgy, in recognition of the distinguished services he had rendered to the science and industry of metallurgy, bestowed upon him the honorary membership of the institution. His death was partly due to weakness induced by severe and continuous overwork, and especially by the loss of vision in one eye due to his close application to microscopic and ultra-microscopic work. His loss will long be keenly felt, especially in Cornwall, by a large circle of personal friends, including the many students who passed through his hands.

IN the University of Pennsylvania's Anthropological Publications, vol. iv., No. 2, Mr. M. R. Harrington describes a remarkable collection of the sacred bundles of the Sac and Fox Indians collected by the expedition maintained by Mr. G. G. Heye. These bundles, containing many heterogeneous articles, are held in the highest veneration, and in many cases the religious observances of the tribe centre round them. The concepts underlying their use are often obscure, but the idea at the basis is that they are endowed with some supernatural power or *mana*, which directly influences the phenomena of life in the interest of their owner. The bundles are supposed to possess a consciousness of their own, to understand what is said to them, and to enjoy offerings presented to them. Some are

used in religion, some in war, while others are of a private nature, and bring success in hunting or in love, heal the sick, promote health, bring luck in sports, gambling, or are used in witchcraft. Some belong to shamans, others are in private hands. A full catalogue with photographs fully illustrates this interesting collection.

IT is generally held that the presence of *B. coli* in pasteurised milk indicates either that the milk has not been properly heated, or that it has been subsequently reinfected by careless handling. In the *Journal of Agricultural Research* for February, S. H. Ayres and W. T. Johnson, jr., describe experiments which suggest that this conclusion may not always be justified. From an examination of pasteurised milk supplied by twenty-four dairies in Amsterdam, Ringeling declared that nearly half of them did not pasteurise or handle the milk properly, since he found *B. coli* in the samples received from ten of the dairies. In recent years many investigators have found that cultures of *B. coli* were easily destroyed at temperatures below 60° C., which is the lowest pasteurising temperature, but certain strains required heating for 30 mins. at 70° in order to destroy them. The authors have studied the thermal death-point of 174 cultures of typical colon bacilli, isolated chiefly from cow fæces, as well as from milk, cream, flies, human fæces, and cheese. These cultures were heated in milk at temperatures ranging from 52° C. to 68° C. for 30 mins. At 63° C., the usual temperature of pasteurisation, 6·9 per cent. of the cultures survived, but only one culture (0·6 per cent.) survived heating to 66° C. Repeated heatings of the cultures that survived the normal pasteurising process showed that 63° C. is a critical temperature for the comparatively few resistant strains, which are able to survive the original heating by the resistance of a few organisms only. If milk is pasteurised at 66° C. or above for 30 mins., the authors expect from their results that no colon bacillus would survive. Consequently under such conditions the *B. coli* test for the efficiency of pasteurisation may be of value. It is, however, possible that a study of a larger number of cultures would show that some strains may survive even higher temperatures.

VOL. xi., part 1, of Records of the Indian Museum contains articles on boring-sponges of the family Clionidæ, by Dr. N. Annandale, on hermit-crabs from the Chilka Lake, by Mr. J. R. Henderson, and on some South Indian frogs, by Mr. C. R. N. Rao, as well as two others. Of five species of hermit-crabs only one is described as new.

THE beauty and delicacy of execution of the two plates (reproduced from photographs) form a striking feature of a memoir by Mr. S. Yehara on Cretaceous trigonias from Miyako and Hokkaido, published as vol. ii., No. 2, of Science Reports of Tohoku Imperial University, Sendai, Japan, series 2 (Geology). The beautiful preservation of the specimens themselves is likewise noteworthy.

IN the *American Naturalist* for March Mr. R. R. Hyde describes a fly of the species *Drosophila confusa*, reared by himself, which differed from the normal form by the curvature of the wings. In the new form the wings curve upwards at an angle of about 45° from the end of the abdomen, and thus somewhat resemble rose-petals, instead of projecting horizontally over and above the abdomen, as in the wild form. Unfortunately, all the members of the new stock died during the hot weather of the summer of 1914.

THE problem of utilising museum collections for the use of children seems to have been satisfactorily solved by the authorities of the Museums of the Brooklyn Institute of Arts and Sciences, whose report for 1913, unusually belated, has just reached us. The museum for children has been brought into close relation with the city schools, the majority of visitors being under fourteen years of age. Well-arranged series are adapted for purposes of instruction, and the library serves the threefold purpose of supplying children with books and magazines relating to their studies, their clubs, and their hobbies. The total attendance was nearly 48,000, and about 2300 parents and other adults attended, some with their children, others desiring help in choosing children's books, while others who began coming in their early days continue their visits. Teachers are encouraged to inspect the collections under the guidance of experienced instructors. The scheme seems to be well organised, and an examination of it may be useful to school authorities in this country.

THE uncertainty that prevails with regard to the correct zoological names of many of the commonest or most familiar animals is a source of great confusion, especially to those who make use of such names without being themselves experts in the study of the particular class of animals dealt with. It is, for instance, extraordinarily perplexing for a medical practitioner or student to see common human parasites appearing under different names in different books, or the same name applied to quite distinct species by different authorities. The efforts, therefore, that are being made by the International Commission on Zoological Nomenclature to fix the names of animals in cases where the matter is in dispute, will be welcomed by all who require to make use of the names. The latest "Opinion" (No. 66) issued by the Commission deals with certain genera of Nematodes and Gordiacea, including the round-worms parasitic in man, namely, *Ancylostoma* (type *duodenale*), *Ascaris* (type *lumbricoides*), *Dracunculus* (type *medinensis*), *Gnathostoma* (type *spinigerum*), *Necator* (type *americanus*), *Strongyloides* (type *intestinalis*=*stercoralis*), *Trichostrongylus* (type *retortaeformis*), *Gordius* (type *aquaticus*), and *Paragordius* (type *varius*). The first of these genera, of which the type is the "Old World Hook-worm," notorious as the cause of miner's anæmia, has hitherto appeared under about a dozen different spellings, including even such barbarous forms as "Agchylostoma"; it is to be hoped that in the future uniformity in this respect will be maintained.

IN Records of the Botanical Survey of India, vol. vi., No. 5, an account is given by Mr. M. S. Ramaswami of a botanical tour in the Tinnevelley Hills.

A good map is included showing the author's route. Of the 470 species collected, thirty-three, or about 7 per cent. of the whole, are endemic to the region, 2 per cent. are purely Ceylon species, and 10 per cent. are peculiar to the South Indian peninsula. Leguminosæ, with fifty-five species, and Rubiaceæ, with thirty-eight, are the most extensively represented natural orders. One new species, *Senecio calcadensis*—a composite—is described and figured.

THE Missouri Botanical Garden completes its first volume with several interesting papers. Mr. E. A. Burt contributes a third paper on the Thelephoraceæ of North America, and details twenty-one species of Cyphella. Mr. R. R. Gates publishes an account on some Œnotheras from Cheshire and Lancashire, with three well-executed plates. The work represents the results of cultivation and hybridisation both at the Missouri Botanical Garden and the John Innes Institution at Merton, and details of the new forms, both mutants and hybrids, are given. In the same part Messrs. Greenman and Thompson describe and illustrate new species of flowering plants from the south-western United States and Mexico.

THE first number of the *Kew Bulletin* for 1915 is mainly occupied by a paper on the semi-parasitic genus Thesium in South Africa, which is illustrated by two plates showing the different types of floral morphology. The genus which exhibits its maximum development in South Africa has been studied in connection with the preparation of the "Flora Capensis." Some 128 species are found to be represented at the Cape, belonging to four well-marked floral types or sections. Two of these, the sections Penicillata, in which the tuft of hairs behind the anther remains free and not attached to the anther, and Annulata, where a ring of hairs at the throat of the perianth replaces the tufts of hairs behind the anthers, are peculiar to the Cape region. A fresh description of the genus is given, a key to all the South African species, and fifty-two diagnoses of new species are published by Mr. A. W. Hill. The distribution of the genus is remarkable. The majority of species are African, but several are spread over Europe and temperate Asia, while two occur in Brazil and one in Australia.

THE permanence of the aroma of hops of a particular variety when grown in another locality has long been a vexed question. Mr. Johs. Schmidt has been carrying out investigations at Carlsberg, and has satisfactorily proved that if pure lines of hops with the "Saaz" aroma from Bohemia, or Oregon cluster hops, with the distinctive and peculiar "American" aroma, are grown in Denmark, they do not lose their characteristic qualities. The experiment of cross-fertilising these varieties with pollen of wild Danish hops has also been made, and it was found that a proportion of $\frac{3}{4}$–$\frac{1}{2}$ the offspring exhibited the characteristic aromas of the female parents, though the plants carrying the aroma did not necessarily retain the external appearance peculiar to the mother plant. These latter results are similar to those recently published by Mr. E. S. Salmon from crossing female Oregon cluster by English male plants. The series of experiments suggest an interesting line of Mendelian research. Mr. Schmidt's paper appears in *Comptes rendus des travaux du Laboratoire de Carlsberg* (11me volume, 3me livraison, 1915).

PROF. A. P. BRIGHAM'S presidential address to the Association of American Geographers, delivered at the meeting in Chicago at the end of last year, is published in *Science* of February 19. Broadly speaking, his theme was that the geographer's "goal is broad generalisation. But the formulation of general laws is difficult and the results insecure until we have a body of concrete and detailed observations." Prof. Brigham's geographical keynote is environment, and certainly in this study the generalisations which have hitherto preceded detailed observations have presented many pitfalls. Prof. Brigham's address was full of suggestions for detailed research in various fields. In an early paragraph he referred to the symposium on the trend of modern geography conducted by G. B. Roorbach, and published in the Bulletin of the American Geographical Society for November, 1914. This marshalling of the views of some thirty geographers, mainly American, but some British, pointed to the same conclusion. It perhaps gave unfair weight to a particular aspect of geographical opinion, inasmuch as fully two-thirds of those whose views were given were professors or other teachers, and the mathematical and cartographical department of the subject received rather scanty treatment. This apart, however, most of them expressed their ideas of the functions of geography in a variety of carefully worded formulæ all of much the same meaning. In indicating fields of research, they were less successful than Prof. Brigham, and some suggestions (in the direction of climatology, for instance) travelled well outside the geographical scope.

DR. BRUCE and Dr. Rudmose Brown gave an account to the Royal Geographical Society on March 22 of Dr. Bruce's expedition to Spitsbergen in 1914. Its object was to investigate Stor Fiord, the great bay to the south-east of Spitsbergen. Difficulties due to the war seriously interfered with their plans, and most of the time was spent in geological work on Prince Charles Foreland, the island off the western coast of Spitsbergen. Most of the paper was devoted to a discussion of the ownership of Spitsbergen. The authors of the papers claimed that the archipelago should be British in virtue of prior claim. After the abandonment of the whaling fishery, the country was long left derelict, but during the last forty years claims for its possession have been advanced by Russia, Norway, and Sweden. In 1909 the United States suggested the establishment of an American protectorate. In 1912 a conference between Norway, Sweden, and Russia agreed that Spitsbergen should remain neutral territory and be jointly administered by those three Powers. Drs. Bruce and Brown maintain that this agreement would deprive Britain of any voice in the future of Spitsbergen, despite her right of ownership due to annexation, exploration, and pre-

ponderating commercial interests They represent this agreement as a practical surrender of Spitsbergen to Russia, which they insist has practically no claim to the country. In the development of the coal-mining the American interests are important though localised, and are of less value than the British. The authors urge that in consequence of the growing commercial development of Spitsbergen some definite government must be established, and they claim that many of those interested in the country consider its interests would be best served by the establishment of a British protectorate.

A SOCIETY of Vulcanology has recently been founded in connection with the University of Catania. The objects of the society are to collect accounts and photographs of the volcanic phenomena of Etna and Sicily and specimens of the materials ejected, and to encourage generally the study of vulcanology. We have received the first four numbers of the *Pubblicazioni* issued by the society. They include papers by Prof. G. Platania on the recent eruptions of Etna and on a proposal for the international organisation for the study of volcanoes.

THE well-known Vesuvian Observatory was built in 1841. Its first director, the physicist Melloni, was removed shortly after taking office, on account of his action in political movements. The observatory then remained closed until 1852, when Palmieri obtained permission to make use of it for his own investigations. Four years later he was appointed director by the Neapolitan Government, though regular observations only became possible when he was provided with an assistant at the close of 1863. Four of the six papers which appear in the last five numbers of the *Bollettino* of the Italian Seismological Society relate to Vesuvian phenomena and to work done in the observatory since the latter date (vol. xviii., pp. 87–338). Mr. A. Malladra studies the rainfall of Vesuvius during the fifty years 1863–1913, and the effects of volcanic gases on vegetation. He also describes the seismographs and seismoscopes in the observatory and various chambers in the neighbourhood. Some of these are of modern Italian construction and are capable of recording strong earthquakes in all parts of the world. An important paper is that by Mr. C. Cappello on the variations in the altitude of Vesuvius from 1631 to 1906, and in the outline of the mountain in the years 1911 to 1914. After the eruption of 1906, the greatest height of the crater rim was 4013 ft. on the west-south-west side, the least 3619 ft. on the opposite side, and the greatest diameter of the crater about 2395 ft.

A PLOT of ground covering seventy-five acres, which includes the remarkable Green Lake near Jamesville, N.Y., with its series of abandoned cataracts, rock channels, and dry plunge-basins, has been given to the New York State Museum by Mrs. Mary Clark Thompson, of New York, and presented in the name of her father, Myron H. Clark, a former governor of that State, and by her desire it is to be known as the "Clark Reservation." The significance of the conformation of the new reservation has, says Dr. J. M. Clarke, in *Science*, been worked out by Prof. Fairchild and Mr. E. C. Quereau. In the course of Prof. Fairchild's work upon the Pleistocene geology of New York State, he demonstrated the accuracy of Mr. Quereau's suggestion that in the retreat of the ice mantle the outflow of the glacial waters was by way of great rivers moving eastward into the Mohawk-Hudson drainage, and in the Green Lake one of these streams cut its rock gorge in the limestones of the Helderberg escarpment and left a series of plunge-basins beneath great cataracts which surpassed the dimensions, as they must have equalled the dignity and grandeur, of Niagara. The lake is surrounded on all but its eastern side by an amphitheatre of sheer limestone cliffs rising to a height of nearly 200 ft., and the depth of the lake is stated to be not less than 100 ft. Water of a deep emerald hue still fills this ancient plunge-basin, without visible outlet or inlet.

A VALUABLE investigation of the "Absorption, Reflection, and Dispersion Constants of Quartz" has been carried out by Mr. W. W. Coblentz, and published as Bulletin No. 237 of the Washington Bureau of Standards. Unlike fluorite, quartz shows a marked absorption in the infra-red at 2μ, and becomes practically opaque beyond 3μ; but from $0{\cdot}25\mu$ in the ultra-violet to $1{\cdot}7\mu$ in the infra-red it is almost perfectly transparent in thicknesses up to 3 cm. Thus, after allowing for losses by reflection at the interface between quartz and air, the transmission is actually found to be 100 per cent., if an allowance of 2 parts per 1000 is made for experimental error. The absorption does not appear to be affected by the direction in which the radiations pass relatively to the optic axis of the quartz.

IN the Annals of the Association of American Geographers, vol. iv., Prof. de Courcy Ward gives an excellent account of the general features of American weather regarded from the point of view of climate. Although climate is usually defined as the average of weather, the irregularities of weather, the variations from day to day, are in some respects more significant than averages: in addition to averages, we require frequencies and rates of change to get even an approximately true representation of climate. Prof. Ward shows how in winter the controlling factor in America is the non-periodic variation arising from the passage of cyclones and anti-cyclones: the storm control, he calls it expressively. In summer, on the other hand, the non-periodic variations are less dominant than the regular diurnal changes: storm-control is subordinate to solar-control. The paper is illustrated by diagrams showing the different paths of cyclones and anticyclones and the changes in the weather as the cyclones and anticyclones cross the country. The distribution about the cyclonic centres is illustrated for different seasons, and the changes which take place at a fixed spot as the cyclones pass over it are shown by reproducing curves from self-recording instruments.

THE February number of the Journal of the Royal Microscopical Society contains a paper which Mr. J. E. Barnard read before the society in December last on the possibility of utilising Röntgen rays in

microscopic work. In his experiments the author has used the soft rays from a tube provided with a lithium glass window. The rays can only pass out of the lead chamber in which the tube is enclosed through a series of fine holes in lead screens in line with each other, and in consequence they strike the photographic plate as a parallel beam. The object to be photographed is placed in contact with the plate, which is enclosed in a light tight box. Plates with thin gelatine films and very fine grain must be used. The time of exposure depends on the thickness and opacity of the object, and the author prefers to use the harder rays from the tube as the opacity increases. The resulting photographs are the same size as the object, and must be enlarged by the usual photographic method. Six reproductions of photographs showing the internal structure of microscopic objects are given in the paper.

THE *Rendiconti* of the Italian Chemical Society (vol. vii., pp. 173–222) has an interesting discussion of the relationship existing between Mendel's principles of heredity and the atomic theory by Prof. C. Vulpiani. A brief survey is given of the recent developments of our views as to the atomic and molecular state, and an attempt is made to show that the natural basis of the hereditary elements which are transmitted according to Mendelian laws is to be found in the molecular or atomic groupings present within the cells, and of which the chromosomes are only the outward visible manifestation. The author very justly emphasises how the Mendelian laws of heredity have led to a more general recognition of the complexity of cell protoplasm. The view that each hereditary element corresponds with some material factor in the ultramicroscopic or molecular structure of the contents of the reproductive cells will undoubtedly lead to more correct conceptions being formed as to the nature of cell protoplasm than those which have in the past been current among biologists.

A PAPER on the processes of manufacture of wrought iron and steel tubes was read by Mr. J. G. Stewart at the Institution of Engineers and Shipbuilders in Scotland on February 16. The author states that it is very rarely that potable waters are found to have any appreciable corrosive effect on steel pipes, and quotes several instances of pipes which have been in service many years with very little deterioration. The principal fear is for the outside of the pipes. Most natural ground, especially clay, is not only innocuous, but is actually a permanent protection to steel pipes from corrosion. In some cases where the pipes are laid through artificially made, or alluvial ground, external protection is desirable. The want has been met by dipping the pipes in a hot bath of Dr. Angus Smith's or other bituminous solution, and in cases where the ground contains an excessive amount of salts and acids which cause corrosion, the additional precaution is taken of wrapping the pipes in coarse jute Hessian cloth saturated with the hot solution, winding it spirally on the already coated pipe.

THE March number of the Journal of the Franklin Institute contains a paper on paints to prevent electrolysis in concrete structures, by Mr. H. A. Gardner, assistant director of the Washington Institute of Industrial Research. An extensive series of experiments on iron rods of 1/2 or 3/4 in. diameter embedded in concrete cylinders 1 ft. long has been carried out by the author to determine what type of paint was most effective. The rods were thoroughly cleaned, and two coats of the paint applied, each being allowed a week to dry. They were then embedded in the concrete, which was aged for a month before the test was commenced. Each cylinder was then immersed in water, and a potential difference of 30 to 100 volts applied for 10 days between two rods in each cylinder, or between one rod and an outside electrode, the current transmitted being observed. In all cases in which an appreciable current passed, the concrete cracked round the anode. The uncracked cylinders were tested for the strength of the bonding between the iron and the concrete. The author concludes that the paint should be prepared from boiled or bodied oils which dry by polymerisation rather than oxidation, that the pigments should be insulators and should give a rough surface, and that the paint should have fine sand scattered over it before it is quite dry.

WE are asked by the proprietors of the Mallock-Armstrong ear defender described in last week's NATURE (p. 131) to say that since January 1 of this year all the defenders sold have been of an improved pattern, furnished with gold-plated gauze wire to resist corrosive effects—such as those of sea air—and generally are more expensive to make than those first put on the market. Accordingly the price is now 4*s.* the pair, instead of 3*s.*, as stated in our notice.

OUR ASTRONOMICAL COLUMN.

COMET 1915*a* (MELLISH).—The following is a continuation of the ephemeris given last week :—

	R.A. (true) h. m. s.	Dec. (true) ° ′ ″	Mag.
April 10 ...	18 14 8	... −3 6·8	... 8·1
12 ...	16 21	... 3 32·3	
14 ...	18 32	... 3 59·7	... 8·0
16 ...	20 42	... 4 29·3	
18 ...	18 22 51	... −5 1·3	... 7·8

The comet is situated a little to the east of η Serpentis.

MEASURES OF SATURN.—From December, 1913, to March, 1914, Prof. Percival Lowell made a series of measures of the ball, rings, and satellites of Saturn with the 24-in. of the Lowell Observatory. They were taken, as he states, "with an eye to the irradiation," and the measures have been deduced to what is commonly taken as the mean distance. These are now presented by the author in a communication to the Lowell Observatory Bulletin No. 66 (vol. ii., No. 16). The diameter of the ball as determined from direct measures, measures of satellites, and measures of B ring is first given, followed by measures of the radius of the ball, breadths of B and A rings, and width of Cassini's division. All these are summed up in a table giving the means of the measures for mean distance, followed by a table of the direct measures of the diameter of Titan.

STARS WITH VARIABLE RADIAL VELOCITIES.—Several communications are contained in No. 267 of the Lick Observatory Bulletin. The first, by Mr. R. E. Wilson,

gives the details of fourteen stars which have recently been found to have variable radial velocities, from plates taken by the D. O. Mills expedition to the southern hemisphere. The same author deduces the orbit of the spectroscopic binary ν Centauri, giving the period as 137·939 days. This star is one of a group of Class B binaries, which have periods of about 130 days. Mr. R. F. Sanford describes his investigation of the orbit of the spectroscopic binary ϵ Volantis, a star of magnitude 4·5 and of Class B5. The new elements show a period of 14·16833 days. A note by the same author on two spectrograms of the interesting irregular variable η Carinæ indicates that the observations of 1913 and 1914 show no evidence of variation in radial velocity.

SOLAR RADIATION MEASURES IN EGYPT.—Bulletin No. 14 of the Helwân Observatory contains an account of some observations of solar radiation which have been carried out at the Helwân Observatory by Mr. Eckersley. It has been shown by Prof. Abbot that values of the "solar constant" vary from day to day, and that even at two stations as far apart as Mount Wilson (California) and Bassour (Algeria) there is a very well-marked correspondence between the values derived at these stations, so that the action of local atmospheric effects is not the cause of the fluctuations. Prof. Abbot considers the outstanding variation to be due to a real fluctuation of the solar constant. In order to investigate this question further, it was decided to make an extended series of observations at Helwân, and this was commenced at the beginning of last year. The account of these measures is given in this paper. For the statistical purpose of comparing the results obtained with those at Mount Wilson, the highest precision of individual observations is not required, but an extended series of measurements uniformly treated is of the greatest value. For this reason pyrheliometer measures of the total energy alone were made. The communication describes the method employed, the reduction of observations, and the results secured. While the value of the radiation derived from the Smithsonian Institution observations at Mount Wilson is 1·932 (mean value of 696 observations taken at Washington, Mount Wilson, and Bassour during the period 1902–1912), the Helwân mean value derived is 1·782. The latter value is considerably less than the Smithsonian mean value, and the cause of the difference is dealt with by the author in subsequent paragraphs. Finally, evidence for the fluctuation during the period of observation is dealt with, and it is concluded that while some of the deviations are probably due to real fluctuation, no conclusive decision can be reached until the Mount Wilson results can be compared.

THE BRILLIANT FIREBALL OF SUNDAY, MARCH 28.

BETWEEN March 21 and 29 eight large meteors were observed, but by far the most brilliant object among them was that of March 28, 7.47½ p.m. Its flight was witnessed by many hundreds of persons from the southern parts of England, as well as from the English Channel, France, and Belgium.

As viewed from London, the meteor sailed slowly along a few degrees under the stars Sirius and Rigel, and further westwards to possibly beyond γ Eridani. Mr. H. P. Hollis saw the meteor from a place about three miles due east of the Royal Observatory, and estimated its duration of flight as between five and six seconds. He did not see the beginning, and it was difficult to trace the exact point of extinction owing to trees behind which the object passed.

Mr. G. P. B. Hallowes was in his observatory at East Howes, Bournemouth, with an astronomical friend, Mr. C. Gregory, when the meteor burst out in the southern sky. It moved from the region of α Hydræ to near Rigel at about the place of ν Leporis. It passed a little above Sirius. Brilliancy far exceeded Venus, and its duration was from three to four seconds. A trail 5° or 6° long followed the nucleus, and the latter burst into fragments at the end. The front of the head was yellow, the rear part red. Diameter, about 15′, or half that of the moon.

Mr. A. King saw the meteor from Scunthrope, Lincolnshire, and from this northerly position its apparent path was very low, being from about 117°−31° to 98°−32°. The brightness was estimated equal to Sirius, the colour yellow-green, and duration 7½ seconds.

Mr. H. Rollason, of Montgomery, Wales, states that the meteor flamed out on the western sky, moving from S.E. to N.W., bursting twice, and enduring altogether five to six seconds. Many other observations have been received or published in the daily papers. As usual, there are discordances, but it is not difficult to derive a real path fairly consistent with the data.

The radiant point is indicated at 192°+4°, or possibly 220°+14°, low in the eastern region of the sky. The height of the object was from about 71 to 23 miles along a path of 175 miles from over the neighbourhood of Vire in France to the English Channel, about 60 miles south of Eddystone. Velocity, 24 miles per second. The meteor seems to have been directed from a radiant comparatively unknown in March, but in April, contemporary with the Lyrids, there is a rich shower of slow and brilliant meteors from 200°+8° near o Virginis.

The recent fireball must have passed almost vertically over Jersey, and from the Channel Islands and western parts of France it created a splendidly luminous effect. As viewed from Bournemouth the apparent size of the pear-shaped head of the meteor was considered to equal half the moon's diameter, which, from the distance of the object, would imply a magnitude of nearly two-thirds of a mile. This must have enormously exceeded the actual dimensions of the stony, or metallic, material composing the meteor. When undergoing combustion, the flame and expanding gaseous vapours from meteors give a vastly exaggerated idea of their real size. It must be very rare that a fireball exceeds one or two feet in the diameter of its material.

I have ascribed a flight of 175 miles to the recent fireball, but it may have been much longer than that. Many of the observers did not detect the object until it had developed considerable brilliancy. The moon was nearing the full at the time of its appearance, but the meteoric visitor startled some of the spectators with its astonishing lustre. W. F. DENNING.

THE INSTITUTE OF METALS.

VOLUME XII. of the Journal of the Institute of Metals, representing the work of the Institute during the second half of 1914, has just appeared. This is one of the first volumes of proceedings to appear since the outbreak of the war, and it indicates that the Institute of Metals has been able to pursue its activities, except for the fact that the autumn meeting which was to have taken place at Portsmouth early in September had to be abandoned. An interesting series of papers, however, are fully discussed by correspondence in the Journal. One of the most interesting from the scientific point of view is the paper by Mr. O. F. Hudson on the critical point at 460° C. in zinc-copper alloys. Mr.

Hudson brings forward evidence, which appears to be quite conclusive, that the interpretation of this point as marking the decomposition of the β phase of brass into $\alpha+\gamma$, which has been elaborated by Prof. Carpenter in a series of papers, is erroneous, and that the β phase merely undergoes a polymorphic change from β to β_1. A striking method of proof adopted by Mr. Hudson is that of preparing a series of alloys in a single piece of metal by the method of superposition. By superposing molten zinc on a layer of solid copper, the alloys can be formed at a temperature below 460° C., and yet a phase which corresponds to β makes its appearance. If what Carpenter has called "apparent β" were really unstable below 460° C., it could never be produced synthetically below that temperature.

Equally interesting from another point of view is the paper, and resulting discussion, by Mr. Arnold Philip dealing with the causes of corrosion in condenser tubes. In the recent Report to the Corrosion Committee of the Institute of Metals, Dr. Bengough and Mr. Jones had been led to reject entirely the view that particles of foreign matter, such as coke, which might set up local electrolytic effects, could thereby accelerate local corrosion and produce "pitting." Mr. Philip traverses this conclusion, and suggests that it was reached on insufficient evidence, while he adduces positive evidence to show that particles of coke can cause local pitting. While such divergence of views among those studying these matters is somewhat unfortunate from the point of view of the practical man seeking guidance for his practice, it serves to show the great need which exists for the further exhaustive investigation of such fundamental questions, and at the same time demonstrates the useful work of the Institute of Metals in encouraging such work and providing a meeting ground for full and—fortunately—dispassionate discussion.

Further papers of special scientific interest are those by Mr. S. W. Smith on the surface tension of molten metals, by Mr. Phelps on the effect of hydrogen on the annealing of gold, and by Messrs. Bengough and Hanson on the tensile properties of copper at high temperatures. In a "Note" Prof. Huntington also deals with the tensile properties of metals at high temperatures, but while Bengough and Hanson find in their results strong support for the theory that the crystals of a metal are held together by something of the nature of an amorphous cement, Huntington urges somewhat vague objections to that view.

Another "Note," contributed by Prof. Carpenter, deals with "The Extraction of Native Copper at Calumet, Lake Superior"; while in itself not uninteresting, it is difficult to understand why this note has been included in the Journal of the Institute of Metals, since it deals with a subject outside the scope of its work and coming well within that of the Institution of Mining and Metallurgy. Although unimportant in itself, such a departure from accepted limitations causes confusion when references have to be looked up.

RECENT WORK ON INVERTEBRATES.

THE journal of a college of agriculture is about the last kind of periodical in which we should expect to find descriptions of deep-sea cephalopods. Nevertheless, three out of the four articles constituting the contents of the seventh number of vol. iv. of the Journal of the College of Agriculture, Imperial University of Tokyo, are devoted to new and rare species of squids, the remaining communication dealing with the eels of the Japanese, Corean, and Formosan seas. In the first of the three articles on squids, all of which are very fully illustrated, Mr. C. Ishikawa describes a new species of the genus Enoploteuthis from the Japan Sea, while in the second Messrs. Ishikawa and Wakiya treat of a number of fragments of a gigantic species taken from the stomach of a sperm-whale. The latter is identified with *Moroteuthis robusta*, of which it forms the fifth known example; in the third article the last-named writers describe a new species of the same genus under the name of *M. loennbergi*.

In an article, illustrated by one coloured and four black-and-white plates, in the February number of the *Entomologist's Monthly Magazine*, Dr. T. A. Chapman describes the larva of the butterfly *Everes argiades*, with figures, not only of the entire caterpillar, but also magnified representations of the shed skins at various stages of development. In the same issue Dr. D. Sharp continues his account of the beetles of the group Holophorini, dealing in this instance with the structure in the genital tube known as the ædeagus, which, as exemplified in *Meghelophorus aquaticus*, is described in great detail.

Aberrant modes of reproduction in certain well-known insects, such as the blue oil-beetle, the parasitic genus Stylops, and the vine-phylloxera, form the subject of an illustrated article by Mr. W. M. Scheyen in the January number of *Naturen*. A continuation is promised.

Writing in the January number of the *Zoologist* of non-sexual reproduction in sea-anemones, as observed at the Millport Marine Biological Station, Mr. R. Elmhirst remarks that although division is usually completed in a few days or weeks, especially among the members of the genus Anthea, yet that he has seen instances in which "double" individuals of Actinoloba showed no change during a period of several months. He also records a case in which an Actinia with two complete discs, mouths, and rings of tentacles retained the same form for close on four years in an aquarium. Possibly, of course, the somewhat unnatural conditions in such an environment may be a factor in these cases.

In *Spolia Zeylanica*, vol. x., part 36, Mr. A. Rutherford mentions that the females of a "glow-worm" (*Dioptoma adamsi*), in addition to the usual terminal light, have a number of other luminous points, apparently arranged in ten transverse rows. Somewhat similarly situated points of light also occur in the smaller males.

In the February number of the *Irish Naturalist* Mr. A. W. Stelfox gives a list of land and fresh-water molluscs from the Dingle Promontory, Kerry. Seventy-four indigenous species are recognised.

R. L.

MINERAL STATISTICS.[1]

PROBABLY the first point that will strike the student of mineral statistics when he sees the report now before us is the extreme dilatoriness of our Home Office. This report, which covers the mineral statistics of the world up to the end of 1912, was not published until the end of 1914; the Chief Inspector endeavours to excuse this delay by a reference to the lateness of the publication of official foreign statistics, but it is a significant fact that a private firm in the United States of America issued a large volume covering the world's mineral statistics for 1913 in July last, so that our own official production is no fewer than eighteen months behindhand. Statistics of mineral production are practically valueless unless they are published promptly, and all the

[1] "Mines and Quarries. General Report with Statistics for 1912." By the Chief Inspector of Mines. Part iv., Colonial and Foreign Statistics.

information under this head afforded by the present publication has been common knowledge amongst all those interested for so long that it no longer presents any features capable of attracting attention.

The most interesting portion of the present report is accordingly that portion that deals with the labour employed in the world's mineral industry. It is shown that the number of persons engaged in this industry exceeded 6½ millions, more than one-third of whom were employed in the British Empire. It is interesting to note that more than one-half of this number was employed in coal mining, and as coal mining in different countries is more readily comparable than any other class of mining, because the conditions under which it is carried on present closer points of agreement, it may be profitable to compare briefly the labour statistics. Out of a total production of 1,250,000,000 metric tons of coal in the whole world, Great Britain alone produces 264,600,000 tons and the whole British Empire 314,500,000 tons, or about a quarter of the whole output. The other large producers are the United States with 484,900,000 metric tons; the German Empire, 255,800,000; Austria-Hungary, 51,700,000; France, 41,100,000; Russia, 31,300,000; Belgium, 23,000,000; and Japan, 19,700,000. It is curious to note that, with the exception of the United States, this list includes all the important nations engaged in the present war. The producing capacity of the miners engaged in this industry in metric tons per worker per annum is shown in the following table :—

Great Britain ...	230	United States ...	671
Australia	535	German Empire...	272
Canada	486	Austria	307
India	129	France	307
New Zealand ...	511	Russia	142
South Africa ...	347	Belgium	157
		Japan	129

It will be seen that with the exception of India, where the labour is almost exclusively native, no part of the British Empire can show so low an output per head as does Great Britain itself, whilst of foreign countries it is only the smaller producers that rank worse than ourselves. In part, this small production is no doubt due to the fact that so many of our thicker and more easily wrought seams are to a large extent worked out, and that we are therefore compelled to work the thinner seams, from which a smaller output per man is necessarily produced. This drawback should, however, have been largely offset by the use of mechanical means for cutting and transporting coal, and it is difficult to avoid the conclusion that the low output is due to the restrictive policy covertly, if not overtly, encouraged by the Trades Unions.

It is some satisfaction to find that British coal mining is conducted with a great regard for the safety of the men engaged in this occupation. The death-rate per thousand workers employed is given as follows :—

Great Britain ...	1·17	France	1·49
British Empire ...	1·24	Russia	4·27
United States ...	3·26	Belgium	1·00
German Empire...	2·44	Japan	5·64
Austria	1·48		

If the death-rate be compared, not per worker but per million tons of output, Great Britain will not appear in quite so highly favourable a light as compared with the United States, for example, that of the former being 4·66 deaths per million metric tons, and of the latter 5·44. Nevertheless, from every point of view our standard of safety may be looked upon as high.

It ought to be added that the above statements are calculated from the data tabulated in the report in question, which gives the figures for the various countries as though they were obtained in the same way, and therefore strictly comparable, which is far from actually being the case. Different countries use different methods of determining their mineral production, the number of men engaged in the industry and the number of deaths due to it, and the figures given are not therefore strictly comparable, though they may be expected to give a rough standard of comparison. One of the objects aimed at for many years by statisticians interested in mineral production was to get an international understanding as to the basis on which all these figures were to be determined, but now that Germany has in a few months destroyed the work of many years of European civilisation, and by her own relapse into barbarism has dragged all other nations down with her, any prospect of agreement on such minor international questions appears to be quite hopeless. H. L.

REPRODUCTION AND HEREDITY.

PROF. J. A. DETLEFSEN (University of Illinois) has made an important contribution to our knowledge of "Mendelian" inheritance by his "Genetic Studies on a Cavy Species Cross" (Carnegie Institution, Publication No. 205, 1914). The research —begun by Prof. W. E. Castle—is of interest as affording information from the crossing of two distinct species, for the wild Brazilian cavy (*Cavia rufescens*) is apparently sharply distinct from the common domestic guinea-pig (*C. porcellus*). The sterility of hybrid animals is known to be a rule admitting of many exceptions. In the experiments with cavies here described, crosses between *C. rufescens* males and *C. porcellus* females gave completely sterile male and fertile female hybrids. By mating the female hybrids with *porcellus* males, quarter-wild hybrids were obtained, again sterile males and fertile females; but by repeated back-crosses of female hybrids to *porcellus* males, individuals with increasing fertility were obtained. "Fertility seemed to act like a very complex recessive character; for the results obtained were what one would expect if a number of dominant factors for sterility were involved, the elimination of which would give a recessive fertile type." The paper is noteworthy because skeletal characters of the parents and hybrids are figured and compared, in addition to the usual external features, such as coat-colour.

A case of sex-limited inheritance in plants is discussed by Mr. G. H. Shull, who has made crosses between the typical *Lychnis dioica* and its variety *angustifolia* (*Zeitschr f. indukt. Abstammungs u. Vererbungslehre*, xii., 5, 1914). The narrow-leafed form is a recessive which reappears in half the males of the F_2 generation. All the F_2 broad-leafed males are heterozygous for the broad-leaf factor, while of the females half are heterozygous, half homozygous for this factor. As regards sex, the female Lychnis is a homozygote and the male a heterozygote.

Dr. Raymond Pearl continues his observations on the reproductive organs of domestic fowls. In a paper on the effects of "Ligation, Section, or Removal of the Oviduct" (*Journ. Exper. Zoo.*, xvii., 3, 1914), he states that these operations have no injurious effect on the growth of the ovary, and that after removal or closing of the oviducal funnel, eggs are passed into the body-cavity, where, if not absorbed at the peritoneal surface, they may cause "serious metabolic disturbances." In the *Journ. Biol. Chemistry* (xix., 2, 1914) Dr. Pearl informs us that injection of the

desiccated fat-free substances of a cow's corpus luteum into a laying fowl at once inhibits ovulation. The possible practical importance of studies in heredity is shown by a short pamphlet from the annual report of the Maine Agricultural Experiment Station for 1914 on improving egg-production by breeding, and by a Bulletin (No. 110) of the U.S. Department of Agriculture (Bureau of Animal Industry), in which Dr. Pearl, with Dr. F. M. Surface, gives "A Biometrical Study of Egg-Production in the Domestic Fowl."

BACK TO LISTER.[1]

WHEN Sir James Crichton-Browne, amongst whose many charms is a singular felicity of phraseology, invited me to undertake this task, he kindly supplied the title. It sounded rather startling, but as I could not think of a better, I humbly accepted it. It shows that I have no great discovery to announce, no new theory to propound, but only to take you back over old, well-trodden ground, to try to interest you in very technical matters, and to suggest that, in this particular case, reaction has overstepped the bounds of moderation, and that, as in many other fields, the most modern ideas are not always the best.

I will not trace the various steps by which Lister was led to his conclusions about the causes of suppuration and hospital diseases, nor draw a lurid picture of the deplorable mortality from these diseases before the introduction of the antiseptic system of treatment. I must, however, give you a short account of his first antiseptic method, which was founded on the discoveries of Pasteur, and explain in what way and for what reasons he afterwards modified it. If I succeed in making this clear it will be easy to understand how the relinquishment of much that he at first considered essential, but which later discoveries proved to be superfluous, led others to give up still more —much more than he ever considered it prudent to do. It will then be maintained that what he feared has come true: that the results obtained to-day, good though they are, are not so good as they would be if we were to return, perhaps not altogether, but almost, to those simpler and safer methods which Lister employed at the end of his active career.

Let us begin by trying to place ourselves in Lister's position during the years preceding 1865, when the writings of Pasteur were first brought to his notice. It was that of every thoughtful surgeon in those days. Of all the dealings of Providence with men—remember I am speaking of sixty years ago—not the least mysterious appeared to be the ordinance that the life-giving air, heaven's blessed breeze, without which life cannot be maintained for more than a few minutes, and on the purity of which man's vigour depends, should carry in some unexplained way the seeds of death and disease, being one day the doctor's greatest friend and the next his deadliest foe.

Physicians were quite sure that the acute specific fevers, such as scarlet fever and measles, were carried on the wings of the wind, and few had any doubt that cholera was borne by the same vehicle. Surgeons were equally certain that erysipelas should be placed in the same class as the acute specific fevers and that the suppuration of wounds depended upon the same agency. It seemed quite obvious, to anyone who thought about the difference in the behaviour of simple and compound fractures, that is, fractures with unbroken skin and those which are complicated by the presence of a wound. Except for this complication the fractures might be identical, but, in pre-antiseptic days, the presence of a wound was almost certain to lead to suppuration of a serious, if not a dangerous nature.

Old Glasgow students speak of Lister contemplating a simple fracture of the leg; the muscles torn and pulped, the limb swollen and shiny, black and blue, and pointing out to them that all this destruction of tissue and extravasation of blood would be surely and safely dealt with by the kindly influences of nature; but that the admission of the air through the smallest wound in the skin would completely change the prospect; the extravasated blood would soon stink, the injured tissues—bone and muscle—would die, and suppuration would take place, which might possibly infect the whole system. It did not enter into the mind of anyone, therefore, to doubt the morbific influence of the air. It was one of those things which appear so obvious that for a time they form the very foundations of belief, such as that the earth is flat and that the sun rises, matters which in more barbarous times laid sceptics open to the rigours of the Inquisition.

This was still the universal belief when Pasteur's discoveries were made known. Pasteur put the finishing touch to the work of many observers, who, during the first half of the last century, had been striving to find out what there was in the atmosphere which gave rise to fermentations of all sorts, and amongst others to that form of fermentation known as putrefaction. So long as fermentation and putrefaction were looked upon as chemical processes it was natural to suppose that one of the gaseous constituents of the air was the cause. But clear thinkers, like John Hunter, saw that this could not be the case.

There are two surgical conditions that prove this:—

(1) If a rib be broken and a sharp fragment injures the lung, large quantities of air may pass from the lung into the pleural cavity, but if the lung be healthy, decomposition never occurs in the putrescible fluid that is always present in the pleura in small quantity.

(2) If air passes into the cellular tissue of the body, as it sometimes does after the same accident, or some other injury of the air passages, large portions of the body may be distended by it to an extent that appears alarming. But again, as the air is effectually filtered on the way, decomposition does not occur and the evil result is only a temporary mechanical one.

Investigators, therefore, began to think that the cause of fermentation must be something solid and possibly living; something so small that it eluded their highest magnifying glasses, and so they adopted different lines of attack.

Some calcined the air, some filtered it, some passed it through causic fluids. There was an old French confectioner named Appert—Citoyen Appert, in the time of the Republic, who anticipated by many years the work of our modern fruit preservers. He succeeded in preserving all sorts of food in well-corked bottles by boiling them for various lengths of time according to the particular article he was dealing with; and his results were so nearly uniform and so remarkable, from an economic as well as from a scientific point of view, that they attracted the attention of the French Minister of the Interior in 1810, and also of the Académie Française.

Unscientific as these observations were, they gave an impetus to the work of chemists and biologists who carried out an enormous number of really scientific investigations in consequence. These were repeated by Pasteur, who made countless others of his own, of marvellous ingenuity. The results of his labours in this particular field before 1865 may be given in a tabular form. He showed that:—

(1) Putrefaction is a species of fermentation.

[1] Discourse delivered at the Royal Institution on Friday, March 12, by Sir R. J. Godlee, Bart., K.C.V.O.

(2) It is caused by the growth of micro-organisms and does not occur independently of them.

(3) The micro-organisms that produce fermentation and putrefaction are conveyed by the air on the dust that floats in it.

(4) These micro-organisms can be destroyed by heat and other agencies, or separated by filtration.

(5) Certain recognisable organisms produce definite and distinct fermentative processes.

(6) All of these organisms require oxygen. Some of them flourish only in the presence of free oxygen (aerobic), others only in its absence (anaerobic). The latter acquire their oxygen from the bodies which, by their growth, they are causing to ferment or putrefy.

(7) Many natural animal and vegetable products have no tendency to ferment or putrefy even in the presence of oxygen, if collected with proper precautions and kept in sterilised vessels.

(8) Spontaneous generation has never been observed to occur, and thus may be regarded as a chimera.

Now it will be observed that Pasteur's work presented Lister with two great fundamental facts.

(1) That putrefaction is caused by germs which can be destroyed by heat and chemicals and separated by filtration.

(2) That germs are carried by the dust in the air.

It is true that both Pasteur and Lister did not fail to recognise that if the air carried the germs it must deposit them upon the surface of everything, and that therefore the surface of every solid and the whole of every liquid must be, or might be, infectious. It is also true that Lister bore this in mind, and acted on the assumption that it was true from the very first. But still it was the air to which he paid and directed most attention—more attention, as we shall see, than it deserved. He probably did not recognise, he certainly did not say, that his precautions with regard to other sources of infection were far more important than those which he took with regard to infection from the air.

The sceptics and cavillers, the believers in spontaneous generation, kept saying, "Show us your germs in the air." They did not doubt that organisms were found in putrefying substances, they could not do that; but they said that they might be accidental, the result of putrefaction, not the cause of it, and asked for proof that germs existed in the air. Pasteur had tried to meet this objection by filtering the air through gun-cotton, which he afterwards dissolved and submitted the solution to the microscope. There were certainly objects which he was satisfied were germs, but the doubters were still unconvinced.

A few years later, about 1869, John Tyndall, whose eloquent addresses on "Dust and Disease" were listened to with breathless attention in this hall, succeeded in showing to the naked eye of untrained amateurs, the existence of, and the amount of, floating dust in any given sample of air, by passing through it a concentrated beam of light. Next he showed that, if the air was left undisturbed, say in a glass flask, the dust settled, and there was nothing for the beam to illuminate. Then he produced the same result by filtering the air, or by raising to a great heat a piece of platinum wire passing through the flask which burned up the dust. Finally, he proved, by a series of charmingly simple experiments, that what he called optically pure air was incapable of setting up decomposition in putrescible fluids, whereas optically impure air invariably caused them to decompose.

Most of these facts were known to Lister in 1865. All the evidence pointed in the same direction; and therefore, stated in the simplest way, the problem seemed to be to kill the germs which might have gained access to the wound before it came under treatment, and to prevent the air from carrying in others afterwards.

He first applied what he now called the antiseptic principle to compound fractures, injuries which, above all others, were liable to be followed by those hospital plagues—pyæmia, erysipelas, and hospital gangrene.

He had to choose between the three recognised methods of excluding the germs—filtration, calcining, and chemical antiseptics—and he naturally selected the last as the most convenient. The first antiseptic he tried was carbolic acid, and as the crude sample he first worked with was insoluble in water he used it undiluted.

His plan for treating compound fractures was, after cleansing the wound, to sponge the whole of the raw surface with this undiluted crude German creosote in order to destroy the germs introduced by dirt or other foreign material at the time of the accident, or that, as he supposed, had been carried to it by the air. The carbolic acid mixed with the blood, caused an antiseptic crust, which he fortified by covering it with a thin piece of block-tin, and this crust effectually prevented the access of unpurified air to the wound; for he left it undisturbed for days or weeks and painted the outside with more of the undiluted acid from time to time.

I wish to impress upon you that in the earliest dressings he used a very strong antiseptic and did his best absolutely to exclude the air, and it is important to note that his results were strikingly good, in spite of the fact that the undiluted acid did actually cause a certain amount of superficial sloughing—or death of the tissues—in the parts to which it was applied. As time went on a purer carbolic acid was obtained which dissolved in water, so he abandoned the caustic undiluted acid in favour of a saturated watery solution: 1 part to 20.

He soon extended the treatment, first to abscesses and then to ordinary operation wounds. The old antiseptic crust was soon given up, and various dressings containing carbolic acid or other antiseptics were employed instead. But for a long time he was so anxious about the air that he irrigated the wound with a solution of carbolic acid in water throughout an operation, and took the most elaborate precautions against allowing any air that had not been submitted to the influence of carbolic acid to reach the wound at the changing of the dressings. He used to say that merely taking out a drainage tube without antiseptic precautions involved a serious risk, because the air which rushed in to take its place might carry some speck of dust and a germ along with it.

In his most palmy days, when he was professor of clinical surgery at Edinburgh (1869-77), and Edinburgh was for the time the surgeon's Mecca, he introduced the spray in order to deal still more effectually with the air. In its most highly developed form the steam spray-producer threw a copious vapour, which was supposed to contain one part of carbolic acid in forty of water, that surrounded the whole region of the operation, and, if the room were small, might even fill the whole apartment with a pungent vapour, to the great discomfort of all concerned. He thought at the time that the momentary contact of the dust with the particles of carbolised water in the spray, or the carbolised atmosphere between the drops would be enough to destroy the germs; but in after years he owned that such a result was impossible.

At this period, though he was still using strong antiseptic lotions very freely, his results were yet more remarkable; and in the meantime, relying on the antiseptic principle, he was doing new operations which, without it, he would have considered to be altogether unjustifiable.

In spite of this, as you know, Lister's treatment, though hailed with acclamation abroad, met with a very ungenerous reception in this country. His compatriots could not understand the great principle that underlay it. They said that there was nothing new in it, or, if there was, it was bad. They said that their results were quite as good as his, or, if they were not, it was only because he paid so much personal attention to his cases. They gave the treatment silly names, showing that they had not grasped the meaning of it; at first it was the "carbolic treatment," now it was the "spray and gauze treatment." This last name was even adopted by Lister's disciples, and thus the spray came to be regarded as a fetish to such an extent that anything which cast a doubt upon its infallibility sorely tried the tender faith of the converted.

But increasing knowledge forced Lister to alter his own beliefs and greatly to modify his practice in the two particulars to which I have especially directed your attention. Thus he more and more diminished the strength of and the amount of his antiseptics; and, having become gradually convinced that infection from the air, far from being the greatest source of danger, was a negligible quantity, he gave up the use of the spray for good and all.

We must now inquire how this came about. Lister always looked upon an antiseptic as a necessary evil, because he saw that anything strong enough to kill germs must damage the living tissues. Therefore in quite early days he tried to do without antiseptics altogether, or at all events to admit nothing of the sort to the wound after the operation was finished. He also recognised from the first that healthy-living tissues had the mysterious power of preventing the growth of micro-organisms; and that this protective power was diminished by anything that lowered their vitality. He further pointed out that the vitality of the tissues varies in different individuals and in different parts of the body, as is illustrated by the well-known fact that healing takes place more readily in infancy than in old age, and in the face than in one of the limbs. The true meaning of this power was not then known. The explanation was given by the marvellous discoveries of Metchnikoff which Lister's own work prepared him to receive, when they were made known to the world.

Everyone now is familiar with the word "phagocytosis," but have you, ladies and gentlemen, really grasped its meaning? It is a sufficiently appalling thought that each one of us, who looks upon himself as a single individual, is only a huge joint stock company. We carry about with us millions and millions of other individual organisms—micro-organisms indeed—but each one endowed at least with life and definite individual functions. Some of them are apparently essential to the success of our bodies as a going concern. Many, even of these, are only waiting for some interference with the vitality of a part, or the whole, of our body, to afflict us with local or general disease, and finally to dissolve us into our elements.

Metchnikoff showed how these malignant organisms are kept at bay. Our very own body is made up of cells, each of which has, so to say, its individual existence and its special functions—almost its special intelligence—a fact which Lister was one of the first to demonstrate. Hosts of these cells—Metchnikoff's phagocytes—form, some of them, our main mobile army of defence. They are not like other defensive cells, such as those of the spleen and bone marrow, confined to their fortresses, though as a rule, they keep their allotted positions. But they can move along strategic railways to any special point of attack, and when they have reached it, there ensues a battle royal with the invading army of pathogenic organisms, which they try to swallow, and, if possible, to destroy. If they are successful, health is restored. It may mean the aborting of a cold in the head, the subsidence of a pneumonia, or the rapid healing of a cut. If, on the other hand, they are overpowered by the invaders, the catarrh may extend to the smallest bronchi, the pneumonia may end fatally, or the wound may suppurate with disastrous results.

These illuminating facts turned the attention of surgeons into another direction; and seeing that everyone knew that the vitality of the phagocytes must be impaired by any mechanical or chemical injury, the tendency was to reduce the strength of the antiseptics and to trust more and more to the phagocytes. Lister himself used weaker and weaker antiseptic lotions, but he never thought it wise to dispense with them altogether. Others, however, being chiefly obsessed with the notion that chemical antiseptics diminish the power of the phagocytes, maintained that their use should be altogether discontinued, and have adopted, or say they have adopted, a treatment which, though having the same object as Lister's, is supposed to be founded upon a different principle. How far this is actually the case it will presently be our business to inquire.

This was one of the reasons why it began to be said that Lister's teaching, like the Old Testament, was obsolete, and must be replaced by a newer and more perfect gospel.

We must now further consider how far the air is really a source of infection. In the early days it was said that the number of germs in the air was enormous. As a matter of fact, such a statement is still true, as is easily shown by exposing a plate of cultivating medium in any room, say in the most up-to-date modern operating theatre.

It was also taken for granted that the large majority of germs were pathogenic—that is, disease producing. But very little was known, in 1865, of the varieties of micro-organisms. It is true that Pasteur had isolated various yeasts or ferments, and had shown that some organisms were aerobic and some anaerobic, and that the words vibrio and bacterium were beginning to be used. But as time went on two very important facts were made out. *First*, that only a small proportion of the flora of the air are pathogenic; and, secondly (and this was one of Lister's own discoveries), that great dilution of a septic fluid very much diminished its chance of infecting a putrescible medium. Thus typhoid pollution of the Nile in a few miles ceases to be a source of danger, and one or two septic organisms introduced into a vessel of blood serum will fail to grow. It is really masses of particulate dirt which are dangerous, because they contain colonies of organisms adequately protected from attack. And, if this applies to attempts at infection of vessels containing blood serum, still more does it apply to the dropping of isolated staphylococci and streptococci on to a wound where the greedy phagocytes are lying in wait to devour them. At every operation scores of germs fall upon a wound—hundreds if it be prolonged—but most of them are those of moulds and other innocuous vegetables which have no chance of growing there; and although there is a possibility of an occasional pathogenic organism being among the number, the risk of its developing is so small, that it is now generally considered to be negligible, and that if one or two should escape into the lymph channel, they will never elude the phagocytes in spleen or bone marrow or elsewhere.

I must now explain how the spray helped to prepare Lister for the acceptance of Metchnikoff's discoveries.

I said it was unpleasant for all. There were some surgeons to whom it was positively poisonous. Amongst these was a friend of Lister's, Thomas Keith, the ovariotomist, whose field of operation was, of course, the peritoneal cavity. In pre-antiseptic days he had obtained results that had astonished the world, by dint of great dexterity, devoted personal attention, and scrupulous regard to cleanliness. His success tried the faith of some, but not of Lister, who was aware of the specially high vitality of the peritoneum, and of other anatomical and physiological peculiarities which diminish the chance of survival of germs, but which are too technical for discussion here.

Keith's success was so great that he hesitated to adopt rigorous antiseptic methods, and Lister at first dissuaded him from doing so, fearing that carbolic acid might dangerously interfere with the vitality of the peritoneum. Besides, at that time he did not fully trust the efficacy of the spray. Keith did, however, for a time use all Lister's methods, including the spray; but this seriously interfered with his health, so he abandoned it, and yet, when he gave it up, his results continued to be as good as when he was using it.

The germicidal powers of the peritoneum are great, but they are only in degree greater than those of muscle, fat, and other tissues. And when it was found that other surgeons, some of them keen disciples, were absolutely forced to give up the spray, or give up surgery, and that, when they chose the former alternative, their results were no worse than before, Lister at last came to the conclusion that the spray was unnecessary, even if it had really made an antiseptic atmosphere, but, as I said before, he now saw that this was impossible. The spray was really only a convenient, unconscious, automatic irrigator. It killed germs on the wound, not in the air, and as such had been very useful during the time when the lesson was being gradually learned that every surgical operation, every surgical dressing, is, in fact, a complicated bacteriological experiment.

The mitigation of the strength of the lotion and the abandonment of the spray seemed to some like lowering the standard. But it was not so. It was not so because the principle remained unshaken, namely, that as organisms are the cause of putrefaction they must be excluded from a wound, or if they had gained access to it they must be destroyed or prevented from growing. Two changes of method had indeed been introduced:—weaker antiseptics were employed because greater respect was paid to the defensive powers of the body, and the spray was given up because opinion had altered with regard to the importance of aerial attacks. Aircraft came to be disregarded, while it was seen that what may be compared to land and water attacks were far more dangerous. The germs on the skin of the patient, the dirt on the hands of the surgeon, the unpurified sponge, the dried clot on a badly cleaned instrument; these were the dreadnoughts and submarines; these were the sappers and miners, the howitzers, and hand-grenades that really decided the fate of the campaign. Thus it became obvious that the precautions taken against such sources of danger, which, though they were adopted from the first, had been overshadowed by the attention devoted to the air-raids, were really of far more vital importance; and much ingenuity was thenceforward devoted to devising means for purifying the skin by mechanical or chemical means, to inventing gloves which would not impair the sense of touch, and also to proving that there was a radical difference between aseptic and antiseptic surgery.

We now come to the question of what is meant by aseptic as opposed to antiseptic surgery. Aseptic is no new word. Lister employed it quite early in his writings, and, though it is plain to see why he called his system antiseptic, it is almost to be regretted that he did not call it aseptic. It would have prevented the confusing suggestion that, as Hunter and others had spoken of and used antiseptics, his system was nothing new, and perhaps it might have saved us from the still more confusing suggestion that there is some fundamental antagonism between aseptic and antiseptic treatment, though they are really the same.

Those who call themselves aseptic surgeons maintain that they do not employ chemical antiseptic agencies. The idea started amongst the gynæcologists who, as has been shown, were working under peculiarly favourable conditions as regards asepsis. They were supposed to use only mechanical means in striving after cleanliness—washings and scrubbings and so forth, which do, of course, remove the deadliest form of danger, particulate dirt. But even these surgeons, or some of them, used to employ freely the most potent of all antiseptics, heat. They boiled their instruments and boiled the water with which they washed out the peritoneal cavity, and some were in the habit of using a pretty powerful antiseptic, sulphurous acid for purifying those most dangerous things, sponges.

Let us now watch an aseptic surgeon at work. Somewhere in the background there must be a very large steriliser for superheating overalls, caps, veils, towels, dressings, and bandages; also a boiler for boiling instruments, and an unlimited supply of boiled (he calls it sterilised) water and normal salt solution.

He spends a long time in scrubbing his hands in soap and water, and probably in spirit of wine, which is an antiseptic; he then puts on his sterilised overall, cap, veil, and india-rubber gloves. Thus, converted from a dangerous into a harmless character, he ought never to touch any contaminated object. But it is to be feared that he sometimes forgets the meaning of his vestures: that he wrongly looks upon them as armour, and, inspired by this confidence, he touches the unclean thing, and then puts his fingers into the wound.

One may be forgiven a passing smile at the unreasoning way in which these details are followed out. Surgeons dress themselves up like white-robed priests to examine the external ear, or to explore those parts of the body that no process on earth can render even approximatelv aseptic.

But to return to our aseptic operation. The instruments, having been boiled, are commonly placed in a tray containing boiled water. Why I have never been able to discover. They would be equally safe if used dry. Probably it is only an imitation of Lister's plan of sterilising his instruments in a tray of carbolic acid lotion.

The patient's skin is almost always purified by a chemical antiseptic, sometimes alcohol, but now usually tincture of iodine. The part to be operated on is then surrounded by superheated dry towels, and the operation proceeds. Superheated swabs have replaced marine sponges. No antiseptic is applied to the wound. Plain boiled water or boiled saline solution is used for washing away clots; preferably saline solution, because it does not interfere with the living cells by osmosis as plain water does.

When the operation is over, a dressing of superheated gauze and wool is fixed by a superheated bandage or by plaister. This, of course, only acts as a mechanical filter of dust, but it is now looked upon with reverence, as if it had some other special virtue, and you may see it applied with extraordinary precautions to septic suppurating wounds and kept on for twenty-four hours, regardless of the fact that it

becomes a septic dressing immediately after application; that it is, in fact, nothing but a beautifully whitened sepulchre full, if not of dead men's bones, at all events of all uncleanness.

Some aseptic surgeons apply their principle to compound fractures and rely solely on mechanical means for removing dirt from the recesses of the wounds; but most, I believe, continue to employ powerful antiseptics for this purpose, and in this class of injury follow Lister's instructions.

I am not so ignorant or bigoted as to suggest that so-called aseptic surgery is a bad way of treating wounds. I know that first-rate results are constantly obtained by means of it. But, I maintain, and here I am repeating what Lister often said to me:—

(1) That it is a troublesome and difficult process, involving for successfully carrying it out an amount of paraphernalia and an amount of training that puts it almost beyond the reach of all except hospital surgeons.

(2) That it is misleading to set it up in opposition to the antiseptic system, because most of its advocates use chemical antiseptics for one purpose or another, and all employ heat with great freedom.

(3) That infections of the skin and consequent later suppuration is more likely to occur than if Lister's methods are followed.

I will now describe one of Lister's operations in his last years at King's College. He did not require a huge autoclave for sterilising. He did not wear gloves, but he purified his own hands and the skin of the patient by a most potent antiseptic, which was called the strong mixture. It consisted of 1 to 20 carbolic acid in 1 to 500 corrosive sublimate. Lister, fortunately or unfortunately, had a very resisting skin; his hands, however, were usually rough, but he did not seem to mind. This was not the case with many of his followers, who could not, or would not, stand the discomfort strong lotions produced. This has undoubtedly been one cause of secession. The instruments and the sponges (he used marine sponges) had been long steeped in strong carbolic acid lotion, but during the operation they were wrung out of a very weak antiseptic solution. The towels placed round the field of operation were also carbolised. No irrigation was carried out. When the operation was complete, a dressing containing an antiseptic substance was applied.

His treatment of compound fractures was never modified after the first few years.

The differences you see are these:—

(1) Lister trusted to a potent chemical antiseptic, instead of to mechanical cleansing and heat, for sterilising the skin, instruments, and the objects likely to be brought into contact with the wound.

(2) He applied a very weak antiseptic in small amount to the wound itself, instead of boiled water or normal saline solution.

(3) Instead of plain gauze he used an antiseptic dressing, which has the great advantage of acting upon any organisms that, after the operation may reach the surface from the sweat and sebaceous glands of the patient.

These differences between the two systems, as thus stated, do not appear to be great, but they are important. "The little more, and how much it is! and the little less and how far away!" For in one there is simplicity and safety, in the other complication and risk. Thus in the first place sterilising by a chemical antiseptic involves no special apparatus. It can be carried out in the humblest cottage. Secondly, the use of an antiseptic during the operation does away with the necessity of the surgeon and his assistants, young dressers, or busy country doctors, or nurses being constantly on the *qui vive* lest their simply aseptic garments should touch some unpurified thing and then convey defilement to the wound. Thirdly, security is provided for against secondary infection from the skin; or secondary infection through the dressing, if the discharges should soak through to the surface and thus supply a neutral track for the germs to travel along.

When I come to speak of results I must necessarily be vague. I have, however, formed the opinion, from much observation and long experience, that the standard as regards suppuration amongst aseptic surgeons is lower than Lister's used to be. If a case "goes wrong," as the common but mischievous expression is, it is looked upon as an unavoidable accident, not as a disgrace. In recent years the term "stitch abscess," has sprung into use. Lister said he never had stitch abscesses. Forgive me for dwelling on them for a moment. The name is applied to suppurations occurring about stitches, and they arise in this way. Our skin is full of small glands for supplying greasy material to the hairs. Organisms are present in these glands, and any weakening of the tissues gives them a chance of doing mischief, the commonest illustration of which is the ordinary boil that starts from the fretting of a cuff or a collar. A tight stitch, or a not very tight one, may do the same. But the risk is very much diminished by thorough purification of the skin, which is much more effectually obtained by following Lister's instructions than by "aseptic" methods. It may be granted that stitch abscesses do not often lead to serious mischief, but they often cause troublesome suppuration in the wound itself and involve delay, and the removal of important deep stitches, which were intended to be permanent. This risk is also lessened by using an antiseptic as opposed to an aseptic dressing. I confess I have never been able to understand the objection to an antiseptic gauze dressing. If the wound heals by first intention the antiseptic substance cannot possibly act upon the raw surface of the wound. Antiseptic gauze has all the advantages of sterilised gauze except that it is slightly more expensive and has none of its disadvantages; in fact, I am confident that it has only been discarded on purely theoretical grounds.

To what extent, then, should we return? I would not urge the use of marine sponges, because they are difficult to clean and expensive, and because cotton swabs are equally efficient. Nor would I recommend the giving up of india-rubber gloves, although I know that they have their dangers, and although I know that they may safely be dispensed with by an antiseptic surgeon. Boiling instruments, I think, should be continued. Otherwise I say that it is only fair to students to tell them, and show them, that by carrying out Lister's technique, it is more easy to obtain the very best results and less likely to fail.

I have only spoken of civil practice, but I would not have ventured to offer you a surgical address, and I could not have hoped to attract your attention if it had had no bearing upon the war which is now raging.

Lister's faithful followers had not only watched with regret what they considered to be a retrograde step in civil practice, but they feared that a war would bring out in relief its weak points.

Wars have occurred of late in distant parts of the world, but we paid little heed to the details. It required a war in our midst, with our own flesh and blood in the trenches exposed to the bullets of the foe, and to the pestilence that walketh in darkness, to bring the matter really home to Englishmen. And when it came, the reports from the front of almost

universal sepsis made us fear that our prognostication had come true, and that the abandonment of antiseptics was, at least in part, accountable. It appears, however, that antiseptics are being very largely used, though with most disappointing results.

The fact must not be overlooked that military surgery is exceptional, and that this particular war is being fought in most exceptional circumstances—trenches dug and monster shells exploding in the highly-cultivated soil of a noted tetanus area like the valley of the Aisne. It is almost impossible for us at home to appreciate what is going on. Listen, therefore, to this graphic extract from a letter I received last week from Sir Anthony Bowlby:—"In this trench warfare you must remember that, if a man is hit, he often falls into filthy mud and water, which may be 3 ft. deep or more. Remember also that the trench is only 2½ ft. wide. *If it is night*, you can only grope about in the dark and can do no dressing of any kind, for you can't even get any clothes off in the dark, and in so cramped a space, and you must try to get the man away to a 'dressing station' half a mile distant, and thence to a field ambulance. *If it is daylight*, you can't get the man out of the trench at all, and he may have to be kept there for many hours, because he would certainly be killed if he was got out of the trench. And the water in the trenches is hopelessly polluted, and soaks his clothes and his wound. It is only too evident that large lacerated wounds, and especially bad bone smashes, are so contaminated that it can never be possible to render them aseptic."

This is a dreadful picture; but all fighting is not trench fighting, and we might have hoped not to be told that all wounds, except bullet wounds, are septic, seeing that a few, at least, come under treatment within a reasonable period, say twelve hours, after infliction.

I have been helping Sir Watson Cheyne to lead a crusade in favour of applying to these dirt-infected wounds Lister's original method of purification by means of undiluted carbolic acid. Not that I advocate it for civil practice, but because I think that the only chance of destroying the organisms of tetanus and gas gangrene, and the best way of dealing with streptococci, is to use the most potent and safest antiseptic which is at the disposal of the surgeon for the purpose.

The suggestion met with the cordial approval of those who, like myself, have employed this agent extensively. But it excited a certain amount of loud criticism from others, who were chiefly impressed by the fact that undiluted carbolic acid produces a certain amount of sloughing. This criticism is easily met, because, if employed with the discretion that may be expected of reasonable people, the slough is unimportant, superficial, and antiseptic—incomparably less suited for the growth of micro-organisms than the extensive and spreading sloughs which they themselves produce. Moreover, these antiseptic sloughs do no harm, but are quickly absorbed if the wound heals antiseptically.

That is not the weak point in the argument. There is, however, another, more difficult to answer, of which our opponents did not make so much. Unfortunately, it cannot be denied that the spores of the bacilli of tetanus resist the action of even undiluted carbolic acid for a very considerable time. Moreover, my colleague, Dr. Thiele, has shown that, if easily recognisable micro-organisms are injected into the subcutaneous tissue, they enter the lymph channels, and may pass into the circulation in the course of a few minutes, long before there is a chance, if the same thing happens in contused wounds, of getting at them with our antiseptics.

Are we, then, to abandon this line of treatment, to fold our hands in despair and say that it is useless to attempt to disinfect any wound in civil or military practice to which spore-bearing or other organisms may have gained access? By no means. All Lister's work cries out against such a conclusion. We must clear our minds of the delusion that carefully planned experiments on guinea-pigs in the laboratory are on all fours with unrehearsed experiments in factories, or on wounded soldiers in the battlefield. Lister did undoubtedly succeed in stopping sepsis in compound fractures and in banishing tetanus and hospital gangrene from his wards, and the experience of generations of surgeons working with a saturated watery solution of carbolic acid has confirmed his conclusions. Surely, then, it may be possible to find a practical way of applying the principle to military practice.

It will not, however, do to brush the argument aside in this way without examining it and answering it. I therefore submit for your consideration a suggestion as to what happens in a case successfully treated antiseptically, that is, one that heals without suppuration.

We do not know for certain in what form the anaerobic spore-bearing organisms are introduced into a wound. I, at all events, do not know of scientifically conducted observations upon the subject. But it is clear that they must be either in the form of bacteria, or spores, or both, probably embedded in decaying organic matter in the soil. If the antiseptic reaches them it destroys the bacteria, together with the other septic organisms. But possibly, or, let us say, probably, it has not sufficient time before becoming too diluted to kill the spores, though it may for a while inhibit their power of development. There, then, these spores lie dormant between a thin layer of carbolised slough and a mass of more or less carbolised blood clot. If sepsis is avoided, the phagocytes at last invade both the slough and the clot, and healing takes place without suppuration. What is the fate of the spores?

We must suppose that, when the carbolic acid has disappeared, as they are embedded in a warm, airless nidus, they germinate, but only to find themselves surrounded by active phagocytes which, if they form a suitable pabulum, destroy them. And so the matter ends so far as the wound is concerned.

This, I maintain, is a reasonable hypothesis and a sufficient answer, and fortunately it is rare indeed, if it ever happens, for tetanus to occur *after* a wound has healed without any suppuration at all; and, moreover, the abolition of tetanus in civil practice has coincided with the reduction in the number of suppurating wounds.

As a further support of the argument, let us now consider the case of the bacteria and spores of tetanus or gas gangrene lying together in an untreated wound, or in one to which less powerful antiseptics are applied, antiseptics not strong enough to destroy the pus-producing organisms. They find themselves, therefore, amongst extensive septic sloughs and decomposing blood-clots in which the phagocytes, if they can penetrate at all, have their time fully occupied with myriads of other organisms, which first weaken and then overpower them. Is it to be wondered at that lockjaw and gas gangrene affect a certain proportion of such cases? On the contrary, the marvel is that these complications are not more frequent.

For, after all, though tetanus and gas gangrene are ghastly things, and make a great impression because the laity knows about them, these diseases are not by any means the most deadly or the most frequent. Probably 40 per cent. of the wounds at one part of the campaign were infected with tetanus, but, up to

date, there have been reported only 207 cases, of which only 2 have occurred since January 20. And it must be remembered that there are effectual ways of dealing with both diseases—tetanus by the prophylactic administration of antitetanic serum, and gas gangrene by very free incisions.

No, the deadliest enemy is the ubiquitous streptococcus, the foe that kills more than shells and bullets. But as it is certainly killed by undiluted carbolic acid or by a 5 per cent. solution in water, there is at least a chance that, so far as streptococci are concerned, wounds may be disinfected even in war, and if these and the other pyogenic organisms are destroyed, there is, as I have shown, great reason to suppose that sporing anaerobes like *Bacillus tetani* would have no chance of growing.[2]

But it may be said: "What about the organisms that have entered the lymph channel and the blood current? What is the good of trying to purify the wound if they have already given us the slip?"

Let us see precisely what Dr. Thiele says, and remember that his experiments are conducted by injecting cultivations of micro-organisms subcutaneously. He maintains:—

(1) That they travel quickly to the nearest lymphatic glands, where they are retarded, perhaps killed.

(2) If not, they make their way along the thoracic duct to the jugular vein and enter the blood stream, and by that channel are conveyed, a few at a time, not in sufficient numbers to be detected by the microscope, to the bone marrow, the spleen, and other parts where groups of cells of the phagocyte class are ready to deal with them.

(3) If the enemy overpowers all these means of resistance they may invade the blood in large numbers and cause general blood-poisoning.

(4) That some are quickly taken up by the blood without passing through the lymphatics.

I must again point out that, in spite of all these alarming facts, general septicæmia probably never occurs if the wound heals without suppuration. To take another simile from the war, the germs that escape into the circulation are like enemy aliens, prisoners of war, or the struggling Turks who crossed the Suez Canal. It is not they, but the main body on the fighting line—that is, the wound—who are engaged in manufacturing the deadly toxins. If they can be annihilated, there is not much fear of mischief from the enemy in our midst. It has never been suggested that germs which have entered the circulation from the wound go back with their ill-begotten progeny to make it suppurate. The argument, therefore, that it is useless to try to make wounds aseptic because some germs have already escaped into the circulation is no stronger than that founded on the resisting powers of spores to the action of antiseptics. Both are the arguments of the bacteriologist rather than of the practical surgeon, and, whilst being treated with all respect, they must not be estimated above their true value.

I cannot hope that your patience is not exhausted. But I trust that you are now convinced of the real danger that may result from neglecting Lister's teaching both in civil and military practice.

As to the latter, which for the moment occupies almost all our thoughts, I should be the last to say that there is only one way of salvation—that, for example, corrosive sublimate is dangerous, or iodine untrustworthy, or peroxide of hydrogen of little value. Still less would I say that military and civil surgery should be run on the same lines. But I still think that undiluted carbolic acid is, according to our present lights, the antiseptic most likely to be practically useful in the rough-and-tumble practice of the battlefield.

And whether or not this may turn out to be the conclusion of our gallant brethren at the front, I would add that the experience of the present war is one of the strongest arguments for rallying to Sir James Crichton-Browne's battle-cry, "Back to Lister."

Long ago it was prophesied that science would stop war by making it too horrible. Are we nearing that blessed result? One fact stands out in spite of the faint hopes I have expressed—that nothing can stop sepsis in war except stopping war altogether.

[2] In using the word anaerobe I desire to own that I do not completely understand its meaning. It certainly has been used in more than one sense, and to-day bacteriologists are not agreed about the effect of oxygen on anaerobes, their need for it, the sources from which they obtain it, and other points. We cannot divide micro-organisms by a clear cut line into aerobes and anaerobes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. L. Mollison has been elected master of Clare College, in succession to the late Dr. E. Atkinson. He was Second Wrangler in the Mathematical Tripos of 1876, and Second Smith's Prizeman, and was elected a fellow of Clare in that year. Afterwards he became successively junior tutor and senior tutor, and was at one time moderator and examiner in the Mathematical Tripos. He was made an Honorary LL.D. of the University of Aberdeen in 1897.

LONDON.—Mr. L. W. King, assistant keeper of the Egyptian and Assyrian department of the British Museum, has been elected professor of Assyrian and Babylonian archæology at King's College. Mr. King's professorship will be a part-time post, and he will retain his position at the museum.

Dr. F. Wood-Jones, lecturer and head of the department of anatomy at the London (Royal Free Hospital) School of Medicine for Women, has been granted the title of professor of anatomy in the University.

WE learn from *Science* that Robert Flersheim has left a bequest of a million marks to the University of Frankfurt.

THE Rockefeller Foundation has, says *Science*, made comprehensive plans for improving medical and hospital conditions in China. The plans are based on the report of the special commission sent by the foundation to China. To carry out this work the foundation has established a special organisation to be called the China Medical Board of the Rockefeller Foundation, of which Mr. J. D. Rockefeller, jun., is chairman. The plan outlined by the commission provides for the development of medical education in China as the first step. With the view of building up a body of Chinese medical men able to teach medical science, the foundation has decided to establish six fellowships, each of 200*l.* a year and travelling expenses, to enable Chinese graduates to study abroad. Six fellows have been appointed, one of whom is already studying in the United States.

THE new buildings of the Mellon Institute of Industrial Research and School of Specific Industries of the University of Pittsburgh were formally opened on February 26 last. The institute, which cost 75,000*l.*, was the gift of Messrs. A. W. and R. B. Mellon, of Pittsburgh; it is provided with complete facilities for the investigation of manufacturing problems and for conducting industrial research in accordance with the system of co-operation between science and industry, founded by the late director of the institute, Dr. R. K. Duncan. By this system, a manufacturer having a

problem requiring solution may give a fellowship to provide the salary of a researcher selected to carry out the investigation desired, the institute supplying every facility for the work. At present twenty-three fellowships are in operation and forty research chemists are at work. At the opening ceremony fifteen honorary degrees were conferred on distinguished Americans. Though the institute possesses its own endowment and has its own board of trustees, it is an integral part of the University of Pittsburgh.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, March 23.—Mr. R. H. Burne, vice-president, in the chair.—R. **Lydekker**: The true coracoid. The element in birds and post-Triassic reptiles universally known as the coracoid is the homologue of the human coracoid process, and its equivalent the true coracoid of the monotremes and mammal-like reptiles.—Dr. F. E. **Beddard**: Certain points in the anatomy of the Cestode genera Amabilia and Dasyurotænia.—B. F. **Cummings**: New species of Polyplax (Anoplura) from Egypt. This paper contained a systematic description of two new species of louse based on a large supply of material in spirit collected on *Acomys cahirinus*, Des., and forwarded by the Department of Public Health in Egypt to the Lister Institute, by whom they were subsequently presented to the British Museum. Both the new species were fortunately collected in large numbers in all stages of development, and an account of the larvæ consequently has been prepared.—J. T. **Cunningham**: The resemblance in form and markings of the plates of paraffin-wax originally obtained by Prof. Kappers, of Amsterdam, to the shells of Molluscs. Examples of these structures had been exhibited at a previous meeting by Mr. R. H. Burne. Mr. Cunningham found that the forms were produced by pouring molten paraffin-wax on to the surface of cold water, and he had no doubt that Prof. Kappers's specimens were produced in the same way by the molten wax running over on to a vessel filled with water. The author concluded that the form and markings were not in either case in any way due to effects of crystallisation as Prof. Kappers supposed.

Geological Society, March 24.—Dr. A. Smith Woodward, president, in the chair.—P. G. H. **Boswell**: The stratigraphy and petrology of the Lower Eocene deposits of the north-eastern part of the London basin. The following divisions of the Lower Eocene occur in the area:—London Clay—basement-bed only; the Pebble-Beds and accompanying sands; Reading Beds; Thanet Beds. The unconformity of the Eocene upon the Chalk is discussed, and reasons are given for regarding the layer of green-coated flints at the bottom of the Thanet Beds in the area as a true basal conglomerate. Evidence is adduced to show that the London Clay overlaps the Lower London Tertiaries, and rests directly upon the Chalk in Norfolk. The Reading Beds also overlap the Thanet Beds in the western part of the area. A hypsometrical map of the Chalk-surface in the London Basin is presented, and a minimum estimate of the unconformity, in terms of thickness of Chalk removed, is given for the northern part of the basin. Stratigraphical details of the various divisions and descriptions of new sections are given. The variations in lithology of the Reading Beds are described, and it is shown that the Pebble-Beds belong lithologically and petrologically to the Reading Beds, but that their scanty fauna is a London Clay one. The distribution of the sarsens in the area is plotted out on a map, and their petrology is considered; it is concluded that, in this district, they are derived from the sands of the Reading Beds. The mineral constitution of the various divisions of the Eocene Beds is discussed in detail.

MANCHESTER.

Literary and Philosophical Society, March 9.—Mr. F. Nicholson, president, in the chair.—Sir Ernest **Rutherford**: Origin of the spectra given by β and γ rays of radium. An account of recent experiments by Sir Ernest Rutherford and Dr. Andrade to determine the wave-length of the very penetrating γ rays emitted from radium. The spectrum of the γ rays was obtained by a photographic method by reflecting the rays from a thin slip of rock-salt. The radio-active source consisted of a fine glass tube containing a large quantity of radium emanation. Special precautions were taken to get rid of the effect of the β rays emitted with the γ rays. A large number of lines were observed in the spectrum over a wide range of wave-length. Two well-marked lines are reflected from rock-salt at 10° and 12°, and correspond to some soft γ rays. There were other strong lines of 1° and 1·7°, corresponding to the very penetrating rays. The shortest wave-length observed was 0·7 Angström unit, which is about 1/50,000 of the wave-length of visible light. This radiation has much the shortest wave-length at present known. An account was also given of the methods for determining the magnetic spectrum of the β rays. The rays from a fine source, passing normally in a strong magnetic field, describe a circular path and fall on a photographic plate. A number of well-marked lines are observed on the plate, which correspond to groups of rays of definite velocity. The speed and energy of the β particle comprising each of those groups of rays from radium products have been accurately determined by Rutherford and Robinson. The general evidence indicates a very close connection between the emission of β and γ rays from radio-active bodies, and that the energy of the groups of β rays are intimately related with the frequency of the γ radiation from which they arise. The author outlined a general theory to explain the connection between the β and γ rays.

PARIS.

Academy of Sciences, March 29.—M. Ed. Perrier in the chair.—Edmond **Delorme**: Artificial limbs for the use of the amputated. Medical treatment is required by the amputated for some time after the wound has healed, if the full benefit of artificial limbs is to be obtained.—J. Comas **Solá**: Certain rapid displacements of short duration registered by photography. In photographs of the sky taken for the purpose of detecting minor planets, a certain number of stars showed changes of position from hour to hour, which could not be attributed to contractions or deformations of the gelatine of the plate.—J. Comas **Solá**: The discovery of a new minor planet.—E. **Keraval**: A family of triply orthogonal systems.—Gaetano **Scorza**: Singular Abelian functions.—M. **Dussaud**: New experiments on sources of light of small surface.—O. **Bailly**: The constitution of glycerophosphoric acid and of lecithin. Egg lecithin is a mixture of two isomers from which a mixture of α- and β-glycerophosphoric acids is obtained, the latter predominating.—G. **Tizzoni**: The infectious nature of pellagra. Results of researches made in Italy and in Bessarabia. Further studies on the micro-organism previously described by the author under the name of *Streptobacillus pellagrae*.—M. **Guépin**: The destruction by suppuration and ablation of a considerable part of the brain resulting in no appreciable trouble.—Pierre **Delbet**: Extra-pericardic cardio-thoracic symphysis.—H. **Busquet**: The compara-

tive pharmacodynamical action of gold in the colloidal and soluble states. So far as gold is concerned, the qualitative reactions on the heart are quite different in the colloidal and dissolved conditions.—B. **Collin**: *Chromidina elegans*.—E. **Kayser**: Contributions to the study of the ferments of rum.

BOOKS RECEIVED.

Descriptive Geometry for Students in Engineering Science and Architecture. By Prof. H. F. Armstrong. Pp. vi+125. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

Structural Steel Drafting and Elementary Design. By C. D. Conklin, Jun. Pp. vii+154. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 10*s*. 6*d*. net.

Canada. Department of Mines. Mines Branch. Economic Minerals and Mining Industries of Canada. Pp. vii+78. The Physical Properties of the Metal Cobalt. Part ii. By Dr. H. T. Kalmus and C. Harper. Pp. vi+48. Report on the Building and Ornamental Stones of Canada. Vol. iii. Province of Quebec. By Dr. W. A. Parks. Pp. xiv+304. (Ottawa: Government Printing Bureau.)

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1914. Pp. 404+Appendix. (London: H.M.S.O.; Wyman and Sons, Ltd.) 4*s*. 6*d*.

Smithsonian Institution. U.S. National Museum. Report on the Progress and Condition of the U.S. National Museum for the Year ending June 30, 1914. Pp. 252. (Washington: Government Printing Office.)

Smithsonian Institution. U.S. National Museum. Bulletin 89: Osteology of the Armored Dinosauria in the U.S. National Museum, with special reference to the genus Stegosaurus. By C. W. Gilmore. Pp. xi+143. (Washington: Government Printing Office.)

A Chaplet of Herbs. By F. Hine. Pp. xv+168. (London: G. Routledge and Sons, Ltd.) 2*s*. 6*d*. net.

The Potamogetons (Pond Weeds) of the British Isles, with Descriptions of all the Species, Varieties, and Hybrids. By A. Fryer and A. Bennett. Pp. x+94+60 plates. (London: L. Reeve and Co., Ltd.) 5 guineas net.

Floral Rambles in Highways and Byways. By Rev. Prof. G. Henslow. Pp. v+294. (London: S.P.C.K.) 6*s*. net.

University of Pennsylvania. The University Museum Anthropological Publications. Vol. vi., No. 2: The Dance Festivals of the Alaskan Eskimo. By E. W. Hawkes. Pp. 41. (Philadelphia: University Museum.)

Annual Report of the Board of Regents of the Smithsonian Institution, 1913. Pp. xi+804. (Washington: Government Printing Office.) 1.10 dollars.

The Evolution of Sex in Plants. By J. M. Coulter. Pp. ix+140. (Chicago: University of Chicago Press; Cambridge: At the University Press.) 4*s*. net.

A Campaign against Consumption. By Dr. A. Ransome. Pp. viii+263. (Cambridge: At the University Press.) 10*s*. 6*d*. net.

DIARY OF SOCIETIES.

FRIDAY, APRIL 9.

ROYAL ASTRONOMICAL SOCIETY, at 5.—(1) A Correction to the Determination of the Constants of the Node, the Inclination, the Earth's Ellipticity and the Obliquity of the Ecliptic; (2) The Elements of the Moon's Orbit: E. W. Brown.—The Errors of Measurements on Astrophotographic Plates: Winifred Gibson.—The Rotation of the Earth: Hermann Glauert.—A Simple Geometrical Construction for Determining the Heliographic Co-ordinates of Sun-spots: F. Henrotean.—*Probable Papers*: Comparison of Magnitude Scales. Sixth Note—The Oxford Magnitudes. With a Preliminary Discussion of the Existence of Obscured Patches in the Sky: H. H. Turner.—The Sun-spot and the Solar Corona of 1914, August 21: A. L. Cortie.

ALCHEMICAL SOCIETY, at 7.30.—The Phallic Element in Alchemical Doctrine: H. Stanley Redgrove.

MONDAY, APRIL 12.

ARISTOTELIAN SOCIETY, at 8.—Phenominalism: C. D. Broad.

VICTORIA INSTITUTE, at 4.30.—Astronomical Allusions in Sacred Books of the East: Mrs. Walter Maunder.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Detection of small quantities of Paraffin Wax in Beeswax, and the Determination of a new constant for East Indian and European Beeswaxes: M. S. Salamon and W. A. Seaber.—The Action of Dilute Acid, Alkalies and Salts on certain Metals: A. J. Hale and H. S. Foster.—Method of Assaying Copper: Arthur Fraser.—Resumed discussion of Dr. Tripp's Paper on "Dickson Centrifuge System of Sewage Disposal."

TUESDAY, APRIL 13.

SOCIETY OF ENGINEERS, at 7.30.—Main Roads, Past and Present, and Modern Methods of Construction and Maintenance: F. Grove.

ZOOLOGICAL SOCIETY, at 5.30.—A List of the Snakes of the Belgian and Portuguese Congo, Northern Rhodesia, and Angola: G. A. Boulenger.—(1) Some new Carnivorous Therapsids in the Collection of the British Museum: (2) The Organ of Jacobson and its relations in the "Insectivora": Dr. R. Broom.—A Note on the Urostyle (*Os Coccygeum*) of the Anurous Amphibia: Dr. G. E. Nicholls.—Some Notes on the Nato Breed of Cattle (*Bos taurus*): E. Gibson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Impact Coefficients for Railway Girders: C. W. Anderson.

WEDNESDAY, APRIL 14.

GEOLOGICAL SOCIETY, at 8.—Further Observations on the Late Glacial or Ponders End Stage of the Lea Valley: S. Hazzledine Warren.

THURSDAY, APRIL 15.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Power Supply of the Central Mining-Rand Mines Group: J. H. Rider.

INSTITUTION OF MINING AND METALLURGY, at 8.

LINNEAN SOCIETY, at 5.—Experiments and Observations bearing on the Interpretation of Form and Coloration in Plants and Animals: C. F. M. Swynnerton.

FRIDAY, APRIL 16.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—President's address Dr. W. Cawthorne Unwin.

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